THE SENIOR SCIENTIFIC GEOGRAPHY

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ELLIS W. HEATON B.Sc.,

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** These books contain Appendixes dealing with the Territorial changes brought about by the War.*

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THE SENIOR SCIENTIFIC GEOGRAPHY.

(With Two Appendixes dealing with the Territorial Changes brought about by the War.)

BY

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PREFACE.

THE "Senior Scientific Geography" is issued to meet the wide demand of teachers who have used the separate books of this series, and want a comprehensive text-book at sufficiently reasonable price to make it available as a class-book in the upper forms of Secondary Schools and Pupil Teachers' Centres. It contains most of the physical Geography of Book I. (some of the harder parts have been omitted and others slightly modified); the whole of Books II., III., and IV. ("British Isles," "Europe" and "North America"); Part I. of "The British Empire," with two special chapters on Australia and New Zealand; Part I. of "Africa," with an additional chapter on South Africa; Part I. of "Asia," with two special chapters on India, China, and Japan. In addition there is an *entirely new section* on "South America," which completes the survey of the world's geography.

Part I. in each case gives a *complete* but *broad* treatment of the Continent or the Empire. The special chapters give additional local detail for important regions. The chapters on the Empire treat the members of the Empire from an *Imperial* rather than from a *Continental* point of view.

My thanks are due to the many practical teachers who have helped me by their fruitful suggestions and valuable criticism, and especially to my colleague, Mr. S. R. Haselhurst, M.Sc.

Tynemouth, May, 1910. ELLIS W. HEATON.

CONTENTS.

SECTION I.

PHYSICAL GEOGRAPHY.

CHAP.		PAGE.
I.	The Shape and Size of the Earth	15
II.	The Earth a Planet. Rotation and Revolution. Day and Night. The Seasons	23
III.	Representation of the Form and Features of the World's Surface. Maps and Map Projections. The Use of Contour Lines	47
IV.	The Earth's Crust; Broad Outlines of Physical Geology; The Bearing of Geology on Geography .	73
V.	The Oceans	85
VI.	The Atmosphere and Climate	109
VII.	Catchment Areas and Drainage Types; Rivers and their Importance to Agriculture, Intercourse and Transit	147
VIII.	Geographical Units; a more Detailed Study of Contrasts and Similarities on the Continents	165

SECTION II.

THE BRITISH ISLES.

PART I.

CHAPTER.		PAGE.
I.	Relation of the British Isles to the Cotinent and to the Atlantic	181
II.	Broad Outlines of the Geological Structure of the British Isles	188
III.	Relation of Geology to Scenery in the British Isles ...	201
IV.	Temperature and Rainfall over the British Isles—Effect on Agriculture	205
V.	The River-systems of the British Isles	211
VI.	Distribution of Mineral Wealth in the British Isles, and its Relation to British Industry	216
VII.	Internal Communications by River, Canal and Railway	223
VIII.	The Export and Import Trade of the British Isles ...	236

PART II.

ENGLAND AND WALES.

SECTION.		
I.	Northumberland and Durham	247
II.	The Eden Valley and the Lakes	250
III.	Yorkshire	252
IV.	Lancashire and Cheshire	258
V.	The Trent Basin	260
VI.	Rivers draining to the Wash	264
VII.	East Anglia...	267
VIII.	The Thames Basin	269
IX.	The Weald of Kent and Sussex	273
X.	Hampshire and the Isle of Wight	277

XI.—The Cornish Peninsula 280
XII.—The Basin of the Severn 282
XIII.—South Wales and its Coalfield 287
XIV.—North Wales and Anglesea 289
XV.—The Isle of Man 290

SCOTLAND.

I.—The Highland Region 291
II.—The Lowlands 293
III.—The Southern Uplands 295

IRELAND.

I.—The Province of Ulster 298
II.—The Province of Leinster 300
III.—Munster and Connaught 302
Typical Exercises on the Maps 306

Section III.

EUROPE.

PART I.

CHAPTER. GENERAL CONSIDERATIONS. PAGE.

I.—World Position, Dimensions, Broad Outlines of Physical Features and Geological Structure ... 307
II.—Climatic Variations over the Continent of Europe, with their Effect on the Vegetation and Agriculture of Different Areas 318
III.—The Mineral Wealth and Industrial Development of Europe 331
IV.—Communication by River, Rail and Sea 341

PART II.

THE COUNTRIES OF EUROPE.

V.—France 353
VI.—Belgium 364
VII.—Holland (Wood-land) 369
VIII.—Germany 372
IX.—Denmark 388
X.—Scandinavia 392
XI.—European Russia 398
XII.—The Danubian States 405
XIII.—Switzerland—the "Playground of Europe" 412
XIV.—Peninsulas and Depressions of the Mediterranean ... 417
XV.—The Balkan Peninsula 421
XVI.—The Italian Peninsula and Islands 425
XVII.—The Iberian Peninsula—Spain and Portugal 431
Questions on the Historical Geography of Europe 436
Exercises on the Map of Europe 437

Section IV.

NORTH AMERICA.

PART I.

GENERAL CONSIDERATIONS.

CHAPTER. PAGE.
I.—World Position, Discovery and Development 441
II.—General Build of the North American Continent—Relation of Geological to Physical Features ... 446
III.—Climatic Conditions on the North American Continent and their Bearing on Agriculture... ... 454

SECTION VII.

ASIA.

CHAPTER.		PAGE.
I.	World Position and Dimensions. General Build of the Continent	747
II.	Climatic Conditions over the Continent of Asia; Three Strongly Contrasted Types; Bearing of Climate on Agriculture and Productions	757
III.	Historical and Commercial Development of Asia; Trade Routes Past and Present; Lines of European Advance	771
IV.	Our Empire in the East: India, Burma and Ceylon ...	784
V.	The Empires of the Far East. China and Japan ...	805

SECTION VIII.

SOUTH AMERICA.

CHAPTER.		PAGE.
I.	World Position, Dimensions, Broad Outlines of Physical Features and Geological Structure ...	819
II.	Climatic Conditions and their Effect on Vegetation and Agriculture	825
III.	Mineral Resources of the South American Continent; Discovery and Development; Commercial Relations and Internal Communications...	840
APPENDIX.	Glossary of Geological Terms	856

PHYSICAL GEOGRAPHY.

CHAPTER I.

The Shape and Size of the Earth.

Form of the Earth.—If the reader has ever ventured out of sight of land on a ship, he will have noticed that *the horizon is a circle*, even though his vessel is constantly changing position as regards latitude and longitude.

Navigators, familiar with all the world's seas, experience

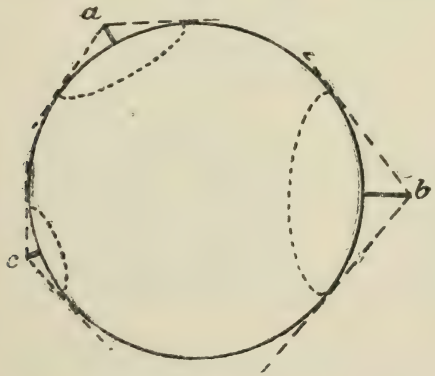


FIG. 1.—THE HORIZON ALWAYS A CIRCLE.

the same in whatever ocean or under whatever clime they may be. It is clear that the form of the ocean's surface, therefore, is everywhere *spherical*, for no other form could always give a circular horizon. The effect of climbing the rigging is only to give a *larger circle* as the horizon.

It is an easy step from this to see that, if the land-surface of the Earth were smooth like the surface of the ocean, similar horizons would be observed. Wherever travellers have found themselves in the middle of a great plain such has

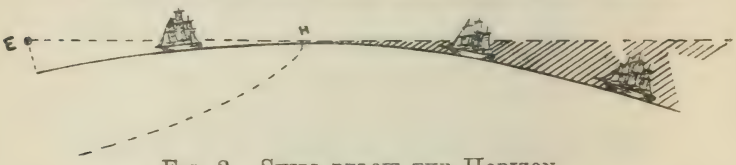


FIG. 2.—SHIPS BELOW THE HORIZON.
Shaded portion hidden from observer, whose eye is at level E.

been the case. We may therefore assume that the form of the Earth *approximates* to that of a sphere.

There are many confirmatory facts, all of which will be familiar to the student. The phenomenon of ships "dropping" beyond the horizon on their outward journey,* and seeming to rise above the horizon on their return to port, is a well-worn illustration.

When the moon is under eclipse, the *boundary of the shadow* is invariably part of a circle. The Earth is the obstacle

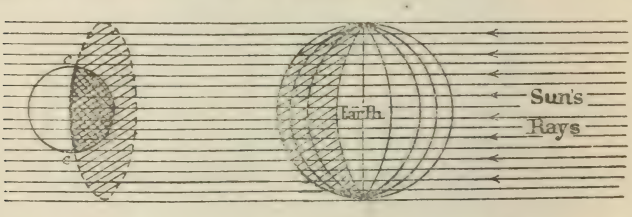


FIG. 3.—THE CIRCULAR SHADOW CAST ON THE MOON BY THE EARTH AT A GIVEN INSTANT IN LUNAR *Eclipse* (NOT PHASES).
[Note that cc^1 is part of a greater circle than the circle of the Moon's circumference.]

casting its shadow on the Moon's surface; so we argue that, since a sphere is the only solid form which can *invariably*

* The opposite phenomenon as seen from the ship is even more striking.

cast a circular shadow, the Earth must be approximately spherical in form.

Further, *analogy with the heavenly bodies* suggests the spherical form of the Earth. The Sun, the Moon and the planets always appear circular in outline from whatever point in space they are observed.

Most important of all, the assumption that the Earth is a sphere suffices to explain all observed astronomical facts

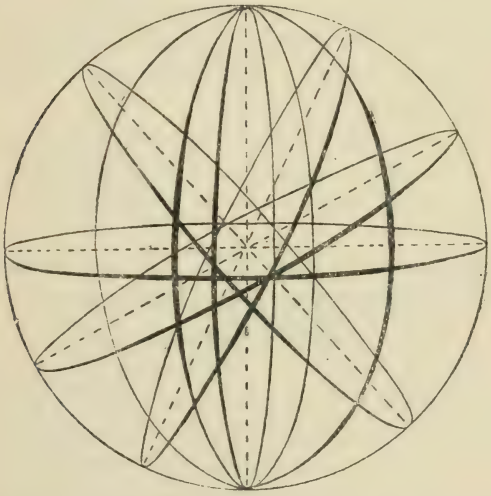


FIG. 4.—A FEW OF THE INFINITE NUMBER OF GREAT CIRCLES POSSIBLE ON A SPHERE.

regarding the Earth, and no other satisfactory explanation is forthcoming.

Size of the Earth.—It is clear that if the Earth is a sphere, we may, *by methods of geometry*, ascertain its size (radius, diameter, circumference, volume and surface area), if we are able to measure accurately the *length of one degree* (1°) on a great circle. By a *great circle* we mean the largest circle

that can be drawn on a sphere. Every great circle bisects the sphere.

Three hundred and sixty times the length of 1° is the length of a great circle, which is what we call a circumference of the earth. The *Equator* is not the only circumference of the earth; it is merely one of an infinite number. Any great circle is a circumference. The *Primary* great circle is the Equator, and all great circles passing through the Poles are *Secondary* great circles.

It remains to be seen how the length of 1° can be measured. Astronomers have proved that *the height of the Celestial Pole* (point in the sky directly over the Pole) *above the horizon is equal to the latitude of the observer.**

In the Northern Hemisphere, the position of the Pole Star (Polaris) is practically coincident with that of the Celestial Pole; hence rough observations of latitude may be made by the student.

Let us take the altitude of the Pole Star at *London* and *Edinburgh* respectively; suppose it works out:—

LONDON, $51\frac{1}{2}°$; EDINBURGH, 56°.

$\therefore$ difference $=4\frac{1}{2}°$. $\therefore$ *difference of latitude* $=4\frac{1}{2}°$.

We now require, not the distance between London and Edinburgh, but the accurate length of the *spherical normal* between an east-and-west line through Edinburgh and an east-and-west line through London (*i.e.*, distance apart of the two parallels). (Fig. 5.)

To obtain this we use a reduced survey map, with scale. Drawing east-west lines through Edinburgh and London, we then obtain the length in miles represented by the *shortest distance* between these two parallels ($=yz$). Suppose $yz=310$ mls. Then $4\frac{1}{2}°$ along a due north-south line on the earth $=310$ mls. It is clear that the north-south line yz is part of a great circle.

* The proof is given in Chapter I. of "The World—Broadly Treated," in this series.

Therefore, if $4\frac{1}{2}°$ of a great circle measure 310 miles, the whole circle will measure $\frac{310}{4\frac{1}{2}} \times \frac{360}{1} = 24{,}800$ miles.

1° would, of course, measure $\frac{310}{4\frac{1}{2}} = \frac{620}{9} = 69$ miles (approx.).

FIG. 5.—FINDING THE LENGTH OF 1°.

Of course, if the form of the Earth is not truly spherical (and such is the case), all calculations such as the above are only approximately correct.

A second method of obtaining the length of 1° on a great circle is based on the fact that the Earth rotates on its axis once in about twenty-four hours. (This is considered fully in Chapter II.)

A point on the Equator moves through

360° in 24 hours, or, 1° in 4 minutes.

If two places on the Equator can be found, at one of which the sun *crosses the Meridian four minutes later* than the other, then the distance between two such places is the length of $\frac{1}{360}$ of the Equator. This distance is found to agree approximately with the result obtained by the first method.

The student may take 25,000 miles as the circumference, and 69 miles as the length of 1° on a great circle.

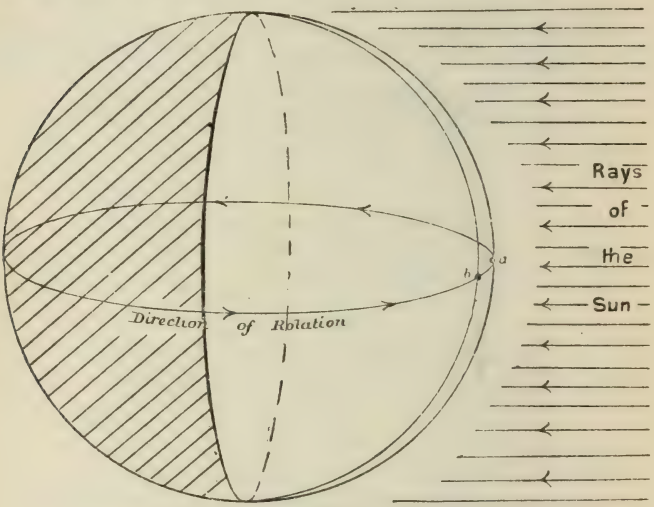


FIG. 6.—LENGTH OF A DEGREE.

(*b*) comes directly under the vertical rays of the sun four minutes later than (*a*). Then the distance between (*a*) and (*b*), measured on the Equator, is the length of a degree. Multiplying by 360 gives circumference *at Equator*.

It becomes an easy mathematical exercise to ascertain the various *constants* of the Earth's dimensions.

$$\text{DIAMETER} = \frac{\text{Circum.}}{\pi} = \frac{25{,}000 \text{ mls.}}{3\frac{1}{7}} = 8{,}000 \text{ mls. (roughly).}$$

$$\text{RADIUS} = \tfrac{1}{2} \text{ Diameter} = 4{,}000 \text{ mls. roughly).}$$

SURFACE-AREA OF THE GLOBE

$$= 4\pi r^2 \text{ sq. mls.}$$

$$= 4 \times 3\tfrac{1}{7} \times (4{,}000)^2 \text{ sq. mls.}$$

$$= 4 \times \tfrac{22}{7} \times \frac{16{,}000{,}000}{1} \text{ sq. mls.}$$

200 million sq. mls. (roughly).

VOLUME OF THE GLOBE
$= \frac{4}{3}\pi r^3$ cu. mls.
$= \frac{4}{3} \times \frac{22}{7} \times (4{,}000)^3$ cu. mls.

The Earth not a True Sphere.—One degree [1°] measured along a meridian is *not the same in every latitude.* The nearer we get to the poles the longer does 1° measure on the Earth. If longer, then the curve of which it forms an arc must be a larger curve than the curve of which an arc of 1° near the Equator is a part. As a result, an arc of the larger circle being *flatter* than an arc of the smaller circle, we see that the Earth is *more or less* flattened in the polar regions.

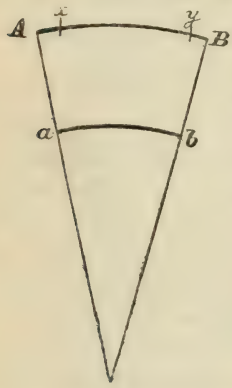


FIG. 7.—THE LARGER THE CIRCLE THE FLATTER THE CURVE.

ab is an arc of a small circle.
AB is an equal fraction of a larger circle.
AB is a flatter curve than *ab.*

[This is well seen if equal lengths, *xy* and *ab*, are compared.]

At the Equator 1° of latitude measures 68·7 mls.
Near the Poles 1° of latitude measures 69·4 mls.
Difference ·7 ml.

The difference is so slight that only accurate measurements reveal it. The comparison with an orange, and elliptical figures drawn on a blackboard, mislead by *exaggerating* the flattening. If the figures were drawn to true scale, the eye could not detect any flattening.

Such flattening in polar regions necessarily makes the *polar diameter shorter* than an *equatorial diameter.*

The flattening at each pole is calculated to be about thirteen and a half miles, making the polar diameter twenty-

seven miles shorter than the equatorial diameter. We may take

P. D.=7,900 mls. E. D.=7,927 mls.

Mass of the Earth.—A century ago, Cavendish determined by a mechanical method the *mean density* of the Earth (compared with *water*). He found it to be $5\frac{1}{2}$. By this he meant that the mass of the Earth is five and a half times as great as the mass of a sphere of water of equal volume.

Professor Boys, of the Royal College of Science, using refined Cavendish apparatus a hundred years later, calculated the Earth's mean density to be 5·527, thus verifying Cavendish's result, and testifying to the excellence of the earlier experiment.

But $5\frac{1}{2}$ is quite *twice the average relative density of the rocks we meet with* on the Earth's surface. Mr. Clarke, an American geologist, has found the average density of eight hundred different rocks to work out at $2\frac{3}{4}$ (just half $5\frac{1}{2}$).

From this we infer that the *materials of the Earth's interior* are much *higher in density* than those of the outer crust.

CHAPTER II.

The Earth a Planet. Rotation and Revolution. Day and Night. The Seasons.

Day and Night.—The Earth receives its light from the Sun. Being a sphere, it is clear that only *one half* of its surface can be illuminated at one time. If the Earth and the Sun were fixed in relation to each other, one half would continuously receive light, while the other half would continuously be in the dark. With one it would be perpetual day, with the other perpetual night.

In most places on the Earth, light and darkness, day and night, succeed each other alternately once in about twenty-four hours. To explain this it is necessary to assume movement of either Earth or Sun.

The Earth's Movements.—If we watch the Sun, we notice it appears to cross the sky in a path which is part of a circle. Whilst it is in view, we are enjoying day. Between sunset and the next sunrise the Sun is out of sight. It, however, reappears on the eastern horizon. It is quite easy to see how early astronomers and geographers inferred that the Sun moved round the Earth, for such an inference appeared to coincide with experience. But when the *enormous distance of the Sun* from the Earth and the *great size of the Sun* itself became known, through astronomical measurement, the idea of the huge Sun moving round the little Earth and over such a big circle in 24 hours was seen to be very improbable.

The Sun is, on the average, ninety-three million miles away from us. Such distance would, therefore, be the *radius*

of a circle covered by the Sun in a twenty-four hours revolution (Fig. 8).

Circumference $= (2\pi r) = 2 \times \frac{22}{7} \times 93$ million mls., covered in 24 hrs.

i.e., rate of motion of Sun $= 2 \times \frac{22}{7} \times 93 \times \frac{1}{24}$ million mls. per hr. = more than 24 million miles per hour. A very improbable solution.

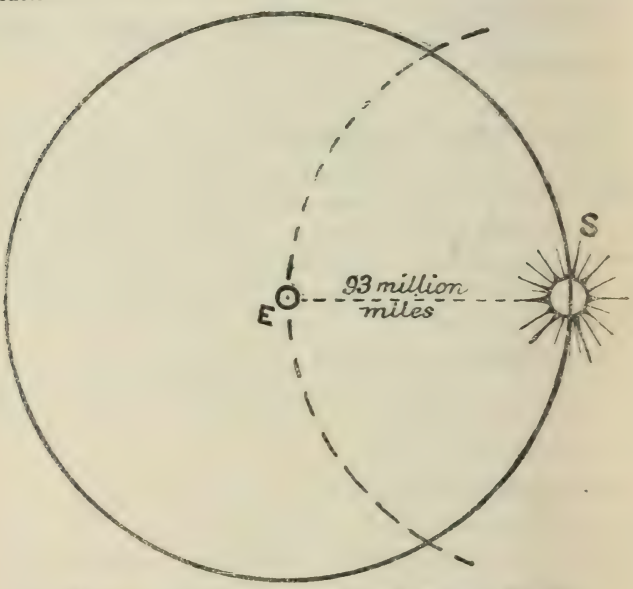


FIG. 8.—RELATION OF THE SUN TO THE EARTH.

Again, the *Sun's diameter* is found to be one hundred and eight times that of the Earth, *i.e.*, (108×8000) miles. It is unreasonable to suppose that a body so large should revolve round a small sphere like the Earth.

There is the alternative of the small Earth moving round the Sun once in twenty-four hours. Again, the path would be equal to the path above mentioned (since the radius of the dotted circle in Fig. 8 is ninety-three million miles), and the rate of motion would be similar.

Rotation of the Earth—Day and Night.—The solution is to be found in the Earth *rotating on its axis* once in twenty-four hours.

Observations of other heavenly bodies like the Sun and the planets show that they rotate, though at different rates. The fact that stars move across the sky during the night, *along circular paths*, and *at the same angular velocity* (*viz.*, proportional to 360° in twenty-four hours), suggests that the same velocity is *apparent* velocity, due to the Earth's rotation, and not *actual* velocity.

Since the Sun and stars travel across the sky from east to west, we must infer that the Earth rotates from west to

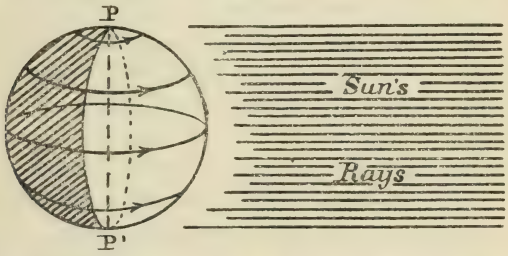


FIG. 9.—EARTH ROTATING ON AN AXIS AT RIGHT ANGLES TO THE SUN'S RAYS.

east, to account for the apparent motion of the heavenly bodies. Experiments are not wanting to bear out the truth of this inference.

Experience of *local time* being *late*, compared with Greenwich, as we go *west*, and *fast* as we travel *east*, (fully considered on *p.* 43), is quite enough to convince us that the *rotation of the Earth is from West to East.*

Even if the Earth and Sun were fixed as regards translatory movement, rotation would suffice to give day alternating with night, in every case except one (*see* Fig. 10).

The case illustrated in Fig. 9 would clearly give equal days and nights all the world over. That illustrated in Fig. 10 would give twenty-four hours' day for one half the

Earth's surface, and twenty-four hours' night for the other. Fig. 11 illustrates a case in which some places would have twenty-four hours' day, and others twenty-four hours' night.

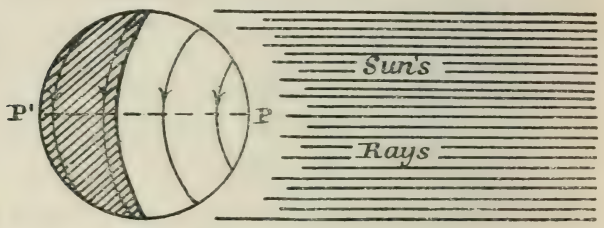


FIG. 10.—EARTH ROTATING ON AN AXIS COINCIDENT IN DIRECTION WITH THE SUN'S RAYS.

whilst most places would vary between these two extremes, having part day and part night in any continuous period of twenty-four hours. The larger diagram (Fig. 12) will show exactly what is meant.

All places between $d'd$ and N will have continuous day, so long as this condition of things remains. Whilst all places between $n'n$ and S will have continuous night. A point of the surface midway between N and S will travel round the

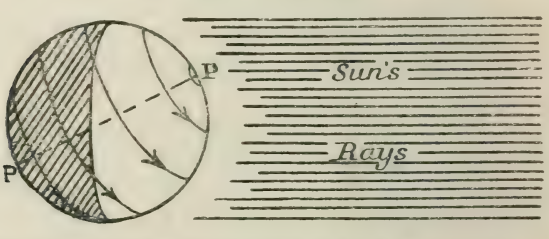


FIG. 11.—EARTH ROTATING ON AN AXIS OBLIQUE TO THE SUN'S RAYS.

circle hh' half journey in the light (thin line), and half journey in the dark (thick line), corresponding to twelve hours' day, followed by twelve hours' night.

It will be easy for the student to see that any place between hh' and dd' will be longer in the light than in

the dark for one rotation, whilst any place between hh' and nn' will be less than twelve hours in the light and more than twelve hours in the dark.

The student will see that, on the whole, Fig. 12 best illustrates the actual condition of things.

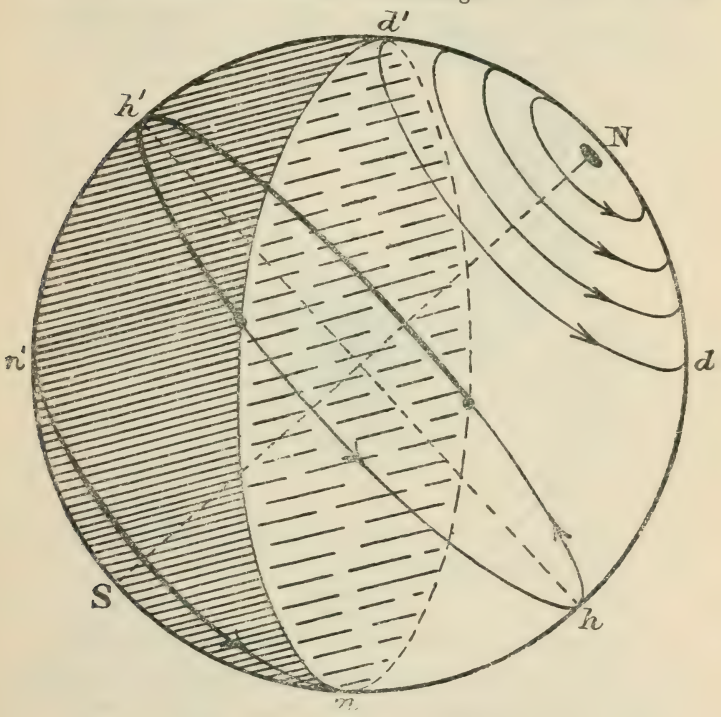


FIG. 12.—DAY AND NIGHT.

The angle of inclination to the Sun's rays is taken at random in Fig. 12. A more accurate consideration of the matter is best left until we have asked whether the Earth has any *translatory, as well as the rotatory movement.*

A rotating earth **fixed** relative to the Sun in space, does not suffice to explain why at any given place, except on the Equator, days **vary** *in length* in the course of a year.

Under such conditions, dd^1 would always have continuous light; hh^1 would continually alternate, with equal days and nights; nn^1 would perpetually be in the dark. For each there would be no change of experience, though the experience of each would be different from that of the other.

So far, we have considered the Earth as a sphere, rotating on an axis inclined to the direction of the Sun's rays. Whilst

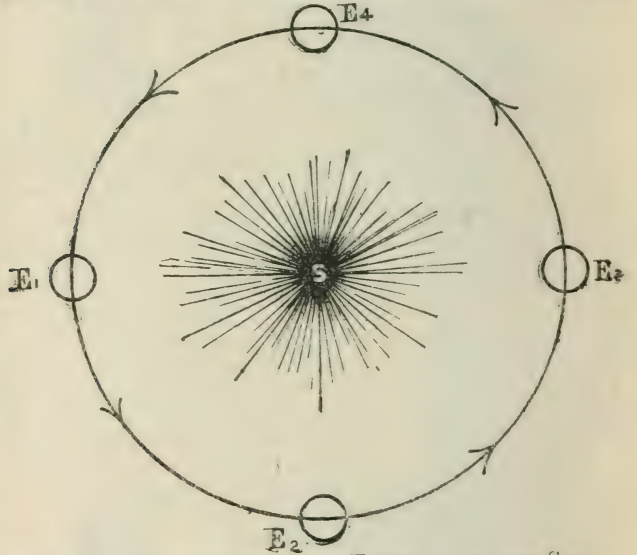


FIG. 13.—REVOLUTION OF THE EARTH ABOUT THE SUN.

this explains day and night varying from latitude to latitude, it does not explain the *variation from season to season at one place*, which is common experience—summer days are long, winter days are short (except on the Equator).

Revolution of the Earth—The Seasons.—The only explanation is to be found in a *translatory motion* of the Earth in relation to the Sun. Let the Earth move round the Sun once in a given period. We saw the absurdity of making the period twenty-four hours. The period is actually a year.

Then the positions E_1, E_2, E_3 and E_4 (Fig. 13) correspond to periods in the year three months apart. E_1 and E_3 represent the position of the Earth at two periods, separated by an interval of six months; let them represent Midsummer and Midwinter. Now we know from experience that, if a place

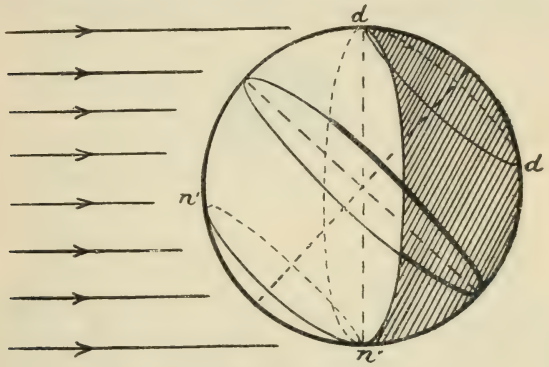


FIG. 14.—SUN'S RAYS REVERSED.

has x hours daylight on *midsummer day*, it will have $(24-x)$ hours daylight on *midwinter day*.

Examples:—

A has 16 hrs. daylight on midsummer day ($=x$ hrs.).
„ 8 „ „ midwinter day $=(24-x)$ hrs.
24 hrs.

Similarly,

B has 24 hrs. daylight on midsummer day.
0 „ „ midwinter day.
24 hrs.

and again,

C has 12 hrs. daylight on midsummer day.
12 „ „ midwinter day.
24 hrs.

A, we know, is a place in mid-latitude; B is at one of the Poles; C is on the Equator.

The problem, then, is to find how this difference between summer and winter (no irregular and haphazard difference, since the sum of the two respective lengths of day is always twenty-four hours) is to be accounted for.

It is clear from Fig. 14 that, if we could reverse the direction of the Sun's rays from that shown in Fig. 11, the condition of things

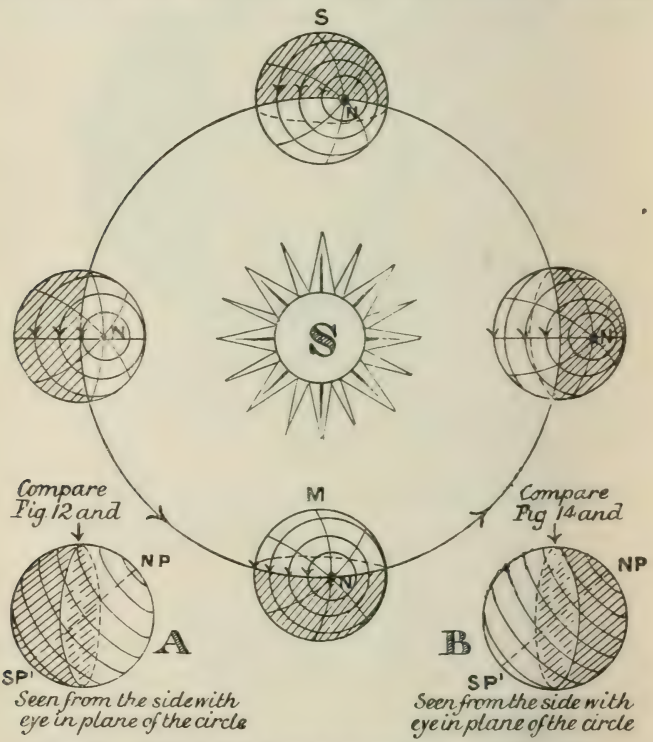


FIG. 15.—BIRD'S-EYE VIEW OF THE ROTATING EARTH.

required would be obtained, *if at the same time the axis of the Earth's rotation remained unchanged in direction in space.*

But this would involve the Sun moving round the Earth from position S_a to S_b.

$$S_b \longrightarrow E \longleftarrow S_a.$$

We have seen the unreasonableness of supposing an immense body like the Sun (332,000 times as heavy as the Earth) moving round a small body like the Earth. Let us now consider the Earth moving round the Sun, as suggested in Fig. 13. The necessary condition of things is obtained, if *the axis of rotation remains unchanged in direction in space.*

If the student will compare A and B (Fig. 15), which are small reproductions of Figs. 12 and 14 respectively, he will see that, if any place has x hours sunshine when E is in position A, it will have $(24-x)$ hours sunshine when position B is reached (half a year).

This diagram would, therefore, appear to illustrate the possibility of seasons. We must test it for other positions than midsummer and midwinter. Take the *Equinoxes** when all places have twelve hours' day and twelve hours' night the world over. These occur midway between midsummer and midwinter, *viz.*, on March 21st and September 22nd.

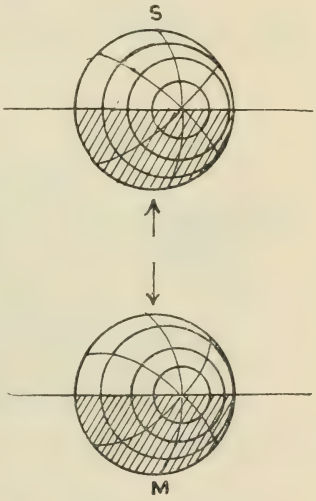


FIG. 16.—THE EQUINOXES.

In Fig. 15, the position of the Earth would be represented by M and S. It is clear that if the Earth's axis of rotation be still parallel to its direction in space for the other positions, each revolving point on the Earth's surface will describe half a circle in the light and half a circle in the dark, *i.e.*, it will experience equal days and nights (*see* Fig. 16).

It remains to find the exact *angle of inclination* to the Sun's rays of the Earth's axis. Let $i°$=the angle.

* Lat., *æquus*, equal; *nox*, night.

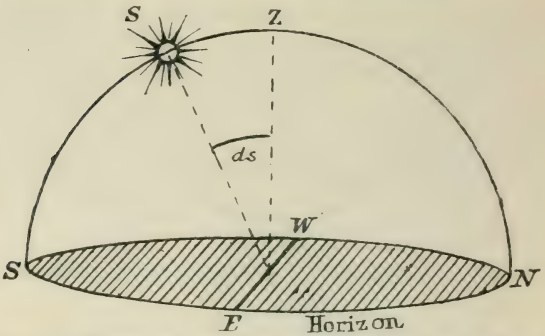


FIG. 17.—POSITION OF SUN IN *x*'S SKY AT NOON ON MIDSUMMER DAY.

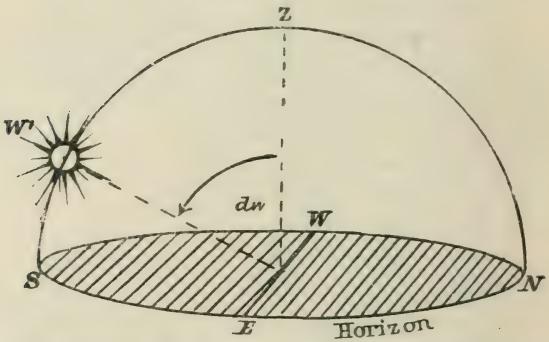


FIG. 18.—POSITION OF SUN IN *x*'S SKY ON MIDWINTER DAY.

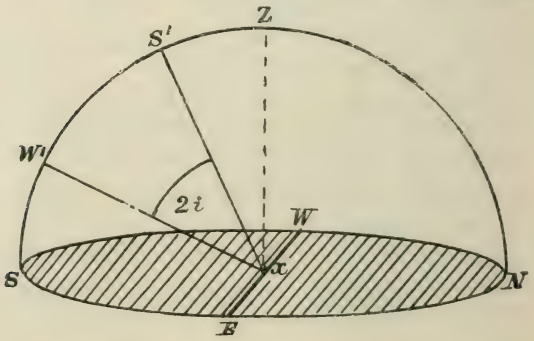


FIG. 19.—MEASUREMENT OF $i°$.

To find i, all that is required is to measure the angle SxW^1 (Fig. 19), where S^1=the height of the summer sun above the horizon and W^1=the height of the winter sun.

These are easily measured by a telescope mounted on a vertical circle whose plane is in a N.-S. direction. (Coloured glasses must be used.)

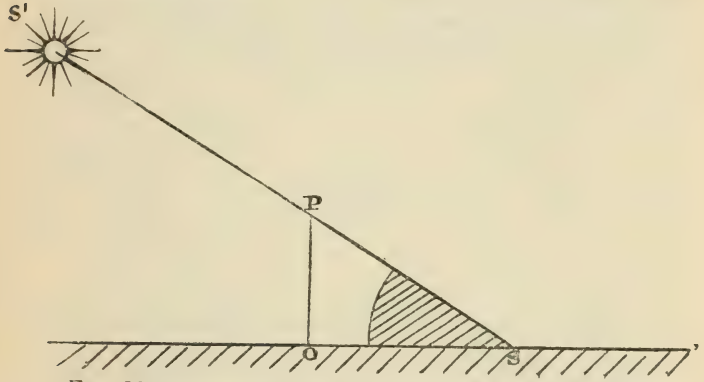


FIG. 20.—PRINCIPLE OF THE GNOMON (*a*). CASE OF MIDSUMMER DAY.

The angle d_s is obtained: d_w also; the difference is halved. The result gives angle *i*.*

A simple method is that used by the early astronomers.

OP is an upright rod, called a **Gnomon.** (*See* Figs. 20 and 21.)

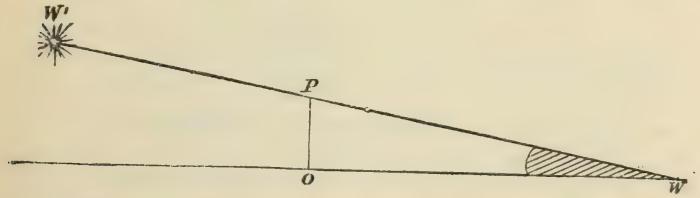


FIG. 21.—PRINCIPLE OF THE GNOMON (*b*). CASE OF MIDWINTER DAY.

OS is the shortest shadow PO can throw, when source of light is noonday Sun.

* For proof see "The World," Chapter II.

OW is the shadow thrown at noon on midwinter day, and is the longest.

By trigonometry, we can measure the angles PSO (Fig. 20) and PWO (Fig. 21), if we know the lengths of OP, OS and OW. Or, by drawing the triangle to scale and using a protractor, a similar result would be obtained.

The difference between the two angles is the $2i°$ of Fig. 19. $2i°$ is found to be 47°, therefore $i = 23\frac{1}{2}°$.

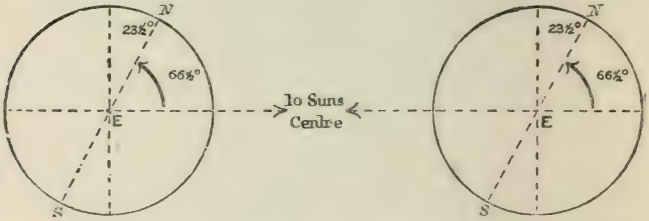


FIG. 22.—INCLINATION OF THE EARTH'S AXIS.

Fig. 22 shows that if $i° = 23\frac{1}{2}°$, then the inclination of the Earth's axis to the plane in which the Earth's centre revolves round the Sun's centre is $66\frac{1}{2}°$; this plane is called the **Ecliptic,** because when Earth, Moon and Sun all have their centres in this plane simultaneously, eclipses occur.

The Earth's Orbit nearly a Circle.—If the Earth moves round the Sun along a circular path, with the Sun at the centre

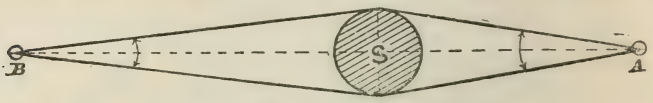


FIG. 23.—ANGLE SUBTENDED BY THE SUN.

then the apparent diameter of the Sun as seen from the Earth will always be the same. But if the Earth is nearer the Sun at one season than another, the apparent diameter will be larger when the Earth is nearer (A), and smaller when the Earth is more remote (B). (Fig. 23.)

Note that angle at A is greater than the angle at B.

By observations of the Sun's angular diameter as seen from different parts of the Earth's orbit, it has been ascertained that *the orbit is not quite a circle, but an ellipse with the Sun in one of the foci.*

The Earth's greatest distance from the Sun—at **Ap-helion*** —compared with its least distance from the Sun—at **Peri-helion** *—is in the proportion of 489 : 473 (Fig. 24).

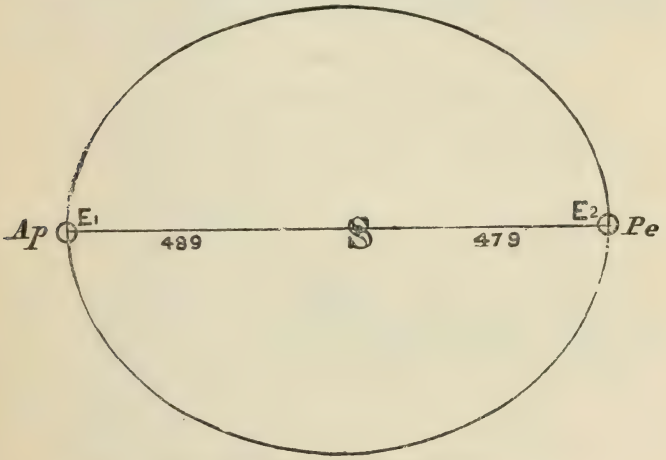


FIG. 24.—THE EARTH'S ORBIT.

Drawn to scale, the ellipse would closely resemble a circle in form.

Were the orbit very elliptical, the great difference between summer and winter heat would make the earth uninhabitable.

The foregoing observations do not give us the dimensions of the orbit. It is necessary to obtain the distances E_1S, and E_2S.

The distance of the Earth from the Sun can be obtained by several *astronomical* methods which scarcely fall within the

* Gk. *Apo*=away from; *peri*=near; *helios*=Sun.

scope of this book. Suffice it to say that in each case the result is the same. *viz.* :—

E_1S=93,564,000 Say, 93½ mill. miles.
E_2S=90,436,000 „ 90½ „ „
∴ difference=3 „ „ (approx.)

It is interesting to note that E_1S, the maximum distance of the Earth from the Sun, coincides in time with the Northern *summer*; suggesting that temperature is dependent on *obliquity of rays* more than on a difference of distance from the Sun.

FIG. 25.—SUN'S APPARENT POSITION IN THE CONSTELLATIONS.

Effect of the Earth's Revolution about the Sun.

Let *a*, *b*, *c*, *d*,..... represent fixed stars. S..... the Sun. E_1, E_2, E_3.....E_0 different positions of the Earth in a single revolution.

When the Earth is in position E_1, S will be projected on *a*, that is, S will appear to be in the constellation, or group of stars, of which *a* is a member. Similarly, when the Earth is at E_2, S will appear to be in constellation of *b*; when the

Earth is at E_3, S will appear to be in constellation of *c*; when the Earth is at E_0, S will appear to be in constellation *i*. With the circle of the year, S will therefore appear in different constellations,* completing a circuit in one revolution of the Earth. The period of one revolution is found to be constant. Astronomers give the period as, approximately, $365\frac{1}{4}$ *solar* days.

The Seasons considered under the special case presented by our Earth, whose axis of Rotation is inclined at $66\frac{1}{2}°$ to the Plane of the Ecliptic.

(1) Midsummer in the Northern Hemisphere.

Note that the Sun is directly overhead at the place T_n on midsummer day, and that, of course, *every* place on the dotted

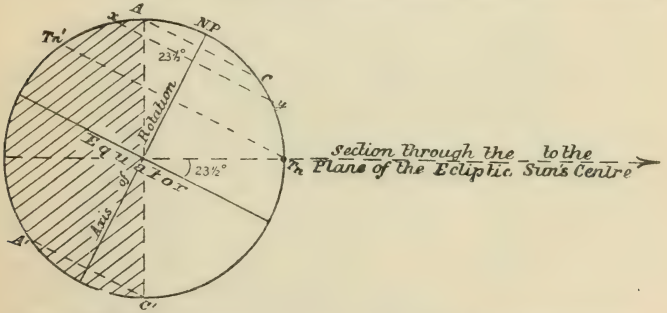


FIG. 26.—MIDSUMMER IN THE NORTHERN HEMISPHERE.

line $T_nT_n^1$ will have the Sun overhead on midsummer day, because of the Earth's rotation.

The Equator has twelve hours day and twelve hours night in one rotation, but the sun is not overhead at noon.

Places north of the Equator have more than twelve hours day and less than twelve hours night.

Places north of AC have twenty-four hours day.

Places south of AC (*e.g.* on *xy*) cannot have twenty-four hours day.

* This gave rise to the twelve signs of the zodiac.

T_n T_n^1 is an important line, north of which no place ever has the Sun overhead.

It is called the Northern *Tropic*, or the Tropic of Cancer.

AC is another important line, south of which no place in the Northern Hemisphere can have twenty-four hours day.

A^1C^1 is a corresponding circle for the Southern Hemisphere. All places south of it have twenty-four hours' night at our midsummer for at least one rotation of the Earth.

AC is called the Arctic Circle.

A^1C^1 is called the Antarctic Circle.

Note that AC and A^1C^1 are $23\frac{1}{2}°$ from their respective Poles and $66\frac{1}{2}°$ from the Equator.

Also that $T_nT_n^1$ is $23\frac{1}{2}°$ from the Equator and $66\frac{1}{2}°$ from the North Pole.

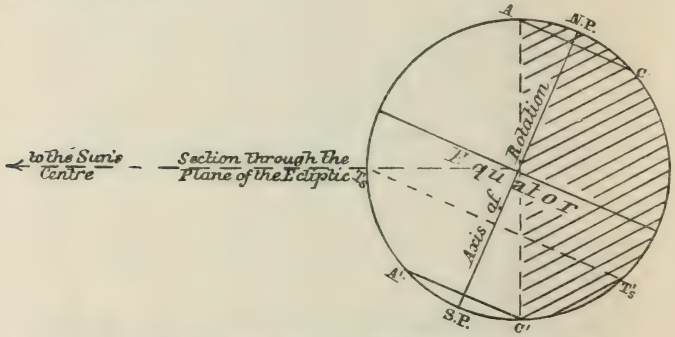


FIG. 27.—MIDWINTER IN THE NORTHERN HEMISPHERE.

(2) Midwinter in the Northern Hemisphere.

The Sun is now overhead for T_s and all places on the rotating circle $T_sT^1_s$.

This line corresponds to $T_nT_n^1$ for the Northern Hemisphere, and is called:—

The Southern *Tropic*, or Tropic of Capricorn.

The names *Cancer* and *Capricorn* are the names of the constellations against which the Sun appears projected at our midsummer and midwinter respectively.

Zones of the Earth.—The circles we have just noted as important *limiting* circles are also of use to define climatic *Zones of the Earth.* One other circle of importance in this respect is the *Great Circle* midway between the *Poles*, which are the *ends of the axis* of the Earth's rotation.

This great circle is familiar to us as the *Equator*, and gets its name from the fact that all the places situated on it days and nights are of *equal* length at all year round. The student should test this with a globe and lamp, so arranged as to illustrate the Earth's motions around the Sun. The Equator

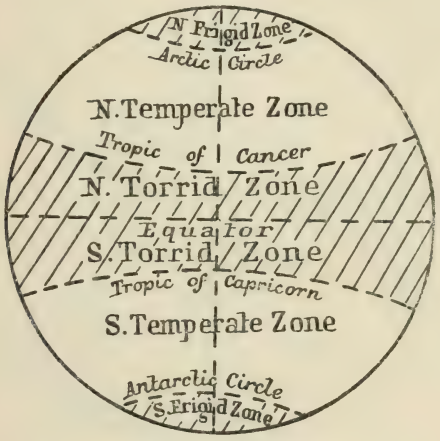


FIG. 28.—ZONES OF THE EARTH.

is the only great circle whose plane cuts the Earth's axis at right angles. The names given to the zones are inserted in Fig. 28.

Use of Great Circles on the Globe.—In order to define the positions of one place on the Earth relative to any other place, it is necessary to fix upon two standard directions, and then state positions in regard to them (Fig. 29).

Let NS be part of a great circle passing through both Poles and the given place A. Through A draw a circle (WE) cutting

NS at right angles. It becomes an easy matter to state the position of B, C, or D...relative to A.

Call the directions AN...North; AS...South;
AE...East; AW...West;

then B is $x°$ east and $y°$ north of A, and so on.

It is important to note how north and south are defined. Travelling along any Secondary Great Circle (which passes through the poles) we are moving north if travelling towards

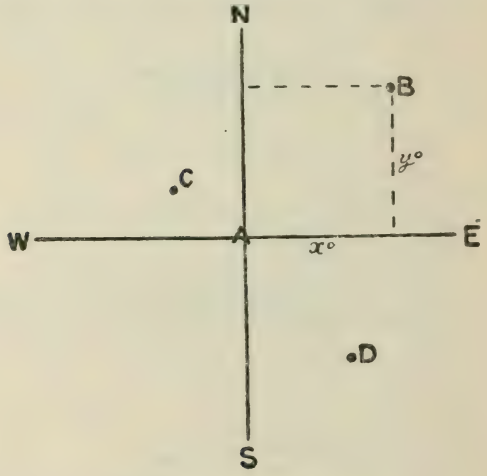


FIG. 29.—CO-ORDINATES.

the North Pole and south if towards the South Pole. If our track intersects one of these Secondary Great Circles we cannot be moving due north or south.

Fig. 30 shows that when two persons are both travelling north, they are not moving along parallel lines but on Secondary Great Circles, which intersect at the poles.

B and M are likewise moving north, although in the southern hemisphere.

If the arrows indicating direction of movement along these great circles were reversed, then the movement would be due south.

These North-and-South Secondary Great Circles are important for other reasons in addition to serving as co-ordinates, and it is for these reasons that this special set of great circles is used.

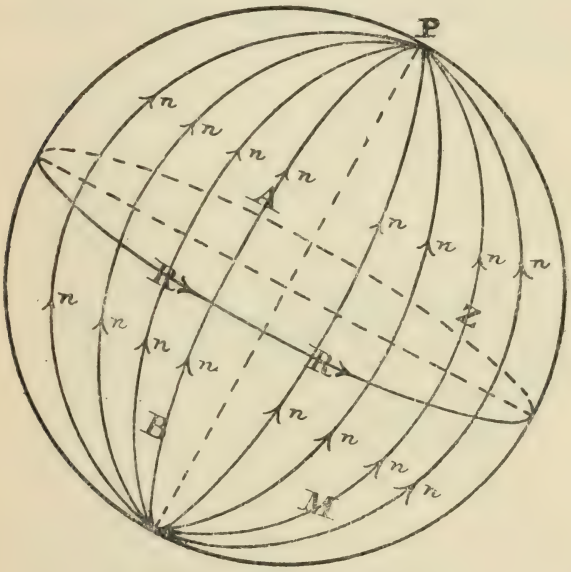


FIG 30.—NORTH AND SOUTH.

[**N.B.** – For the *purpose of co-ordinates* it was *not necessary* to take the poles of the axis of rotation as the points of intersection; any other point on the sphere would have served equally well.]

It is clear that all places on the Secondary Great Circle *abc* (Fig. 31) have *noon* at the same instant (that represented in the diagram), and that by rotation *def* will in time come into

the position occupied, for the moment, by *abc—ghi* and *ikl* following on.

Thus all places on *half* a great circle passing through the Poles have noon at the same instant; those on the other half have midnight.

It is fitting, therefore, that these circles should be called Meridians* (=mid-day lines). A meridian serves the double function of N.-S. co-ordinate and a mid-day line, or *locus of all places having noon at the same instant.*

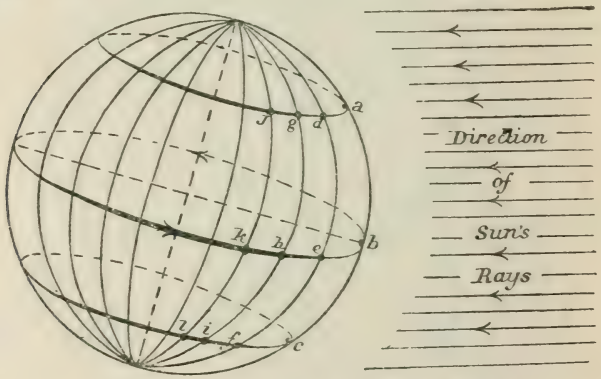


FIG 31.—MERIDIANS AND LOCAL TIME.

In all cases where co-ordinates are used to determine position, it is necessary to determine upon *two axes intersecting* at a given point (called in Geometry, the Origin). All geographers have fixed upon the Equator as one desirable axis (a circle, *not* a straight line, in spherical co-ordinates), and different countries use the great circle on which their own national observatory lies for the other axis. Thus for Great Britain and Ireland the line through Greenwich is chosen. The French use Paris; Germany uses the Island of Ferro; Russia selects Pultowa. These lines are marked 0°.

* L. *Meridianus*=pertaining to mid-day.

When used as co-ordinates, meridians are called Lines of Longitude. Circles parallel to the Equator used as corresponding co-ordinates are called Lines of Latitude, whence we get the definitions:—

(i.) **Longitude** is distance east or west of a fixed meridian.

(ii.) **Latitude** is distance north or south of the Equator.

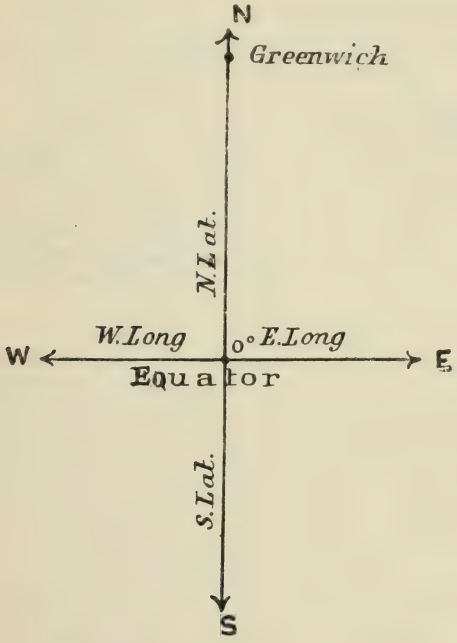


FIG. 32.—THE LINE THROUGH GREENWICH.

Latitude and Longitude.—Local Time.—By means of latitude and longitude the surface of the earth can be mapped on a globe, and the true form of continents and oceans defined:

Now *the height of the celestial pole is equal to the latitude of the observer;* hence at any place the latitude is easily obtained. We must now consider how longitude can be ascertained.

Suppose x is an islet, and that the clocks on the islet mark 12 o'clock at true noon. If a captain sails from London, and carries a chronometer keeping accurate London time, he will, of course, find a discrepancy between his time and that of the clocks on the islet. Fig. 33 shows that when it is noon at London the islet x is an angle xCx' away from the

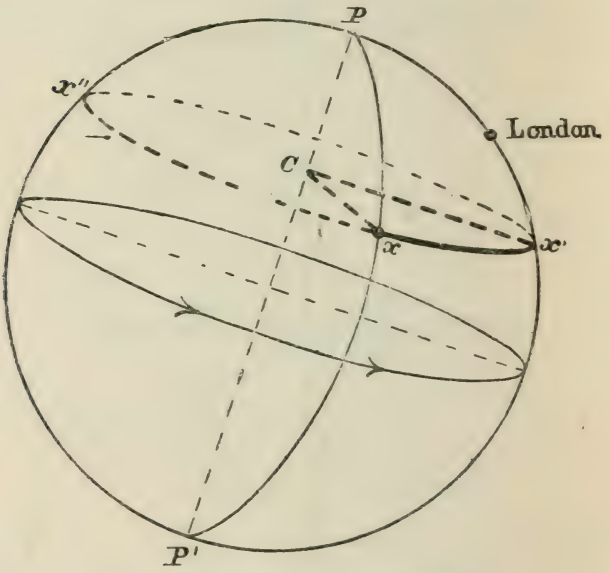


FIG. 33.—LONGITUDE AND TIME.

position of noon. Only when PxP' has rotated to the position $Px'P'$ will the island experince noon.

Suppose the arc xx' of the circle $x''xx'$ measures 60°. Then, since a rotation of 360° is made in 24 hours, a rotation of 60° will be made in $\frac{24}{360} \times 60$ hours$=4$ hours; *i.e.*, x is as yet 4 hours in time from noon, therefore the difference between the captain's accurate chronometer and the accurate local

time on the islet is 4 hours. The captain goes through an argument the reverse of the above.

Says he .—

$$4 \text{ hrs.} = \tfrac{1}{6} \text{ of } 24 \text{ hrs.}$$

$$\therefore \text{ difference of longitude} = \tfrac{1}{6} \text{ of } 360° = 60°.$$

In the diagram, Fig. 36, we assumed that the Earth rotates from west to east. x is in west longitude, compared with London. Its time will obviously be four hours *behind* that of London, *viz.*, 8 a.m., when London has noon ; but at any hour of the day the local time will be four hours late by the captain's chronometer. From this he argues that x is west of London. Had the clocks of the island been in advance of his chronometer, he would argue *east* longitude, proportionate to the amount the local clocks were fast.

The Earth rotates 360° in 24 hrs.

" " " 15° " 1 hr.

" " " 1° " 4 mins.

Thus a difference of four minutes between accurately set and accurately-working chronometers means a difference of 1° of longitude. This gives us one way of determining longitude in countries where local time is accurately kept. Other methods are used by astronomers (and, of necessity, by navigators for longitudes at sea), but these are outside the scope of a text-book on Geography.

Given latitude and longitude, the position of any place can be accurately indicated on a globe.

The Earth a Planet.—Observations of the heavenly bodies show that several spheres bear similar relations to our Sun that the Earth does, in that they revolve in elliptical orbits about the Sun whilst they rotate upon their axes. Moreover, they have moons (called Satellites) revolving around them, as our Moon revolves about the Earth. The lengths of their respective days, months and years, of course, differ from those for the Earth, as do also their respective dimensions

and masses. (*True stars* differ from these in being sources of heat, like our Sun, and fixed in relative position to it, not revolving about it.)

This group of heavenly bodies having similar properties and bearing similar relationships to our Sun, is collectively called the *Solar System*, the individual members being termed *Planets*.

The word planet means a wanderer, and refers to the *apparently* irregular movements of the planets as projected against the constellations, due to their moving in different orbits with different velocities whilst observed from the Earth, which is moving in another orbit, with still another velocity.

[The student who can examine an **Orrery** and a **Planisphere** will be helped greatly in grasping this somewhat difficult chapter.]

* Gk. *planetes*=wanderer.

CHAPTER III.

Representation of the Form and Features of the World's Surface—Maps and Map Projections; the Use of Contour Lines.

[The student should study types of all the maps mentioned in this chapter.]

To map a *globular* surface upon a *flat* sheet of paper quite accurately is an obvious impossibility. Only on a globe can

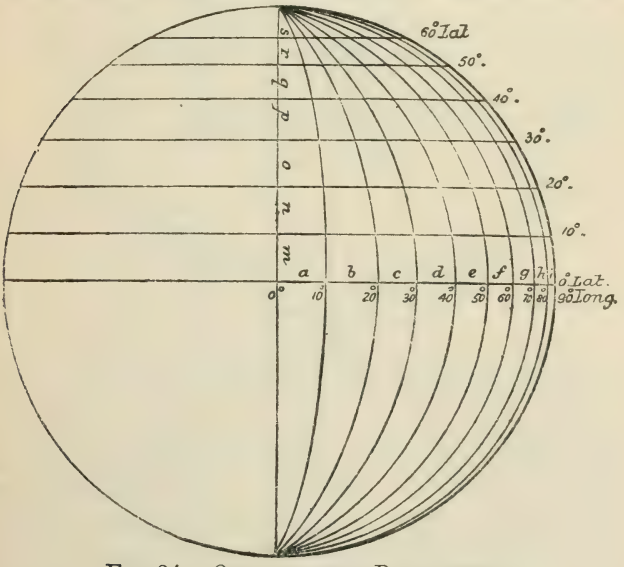


FIG. 34.—ORTHOGRAPHIC PROJECTION.

a globular surface be accurately represented. But *approximations* to truthful representations can be obtained on flat maps

by means of *map projection.* They *are* approximations, however, and the student must constantly correct his impressions of size and form by consulting an accurate globe.

1. **The Orthographic Projection** represents the globe as it would appear to an observer an infinite distance away, so far away that all points on the map are connected to the eye of the observer by parallel lines. In this projection countries

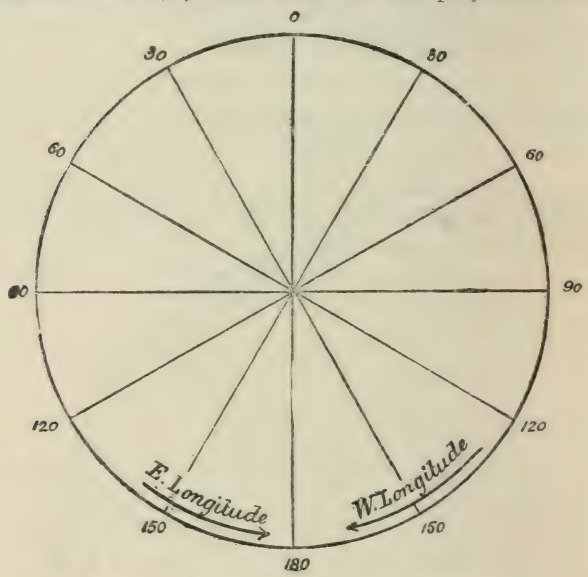


FIG. 35.—ORTHOGRAPHIC POLAR PROJECTION.

near the circumference of the map are greatly diminished in area and distorted in form. Each space [(*a*) 0°—10°; (*b*) 10°—20°; (*c*) 20°—30°, etc.] marked off on the equator is equal in length on a globe, but rapidly diminishes on an orthographic map from the middle point of the map towards the east and west respectively. The meridians appear as converging curves. The parallels of latitude appear as parallel straight lines.* Again the distances between these parallels

* *See* Fig. 34, *p.* 47.

equal distances on the globe (and, indeed, on the circumference of the map of a hemisphere such as Fig. 34), are unequal on all other lines except the peripheral lines, and the decrease in distance is greatest on the middle line of the map (0° Long. in Fig. 34). Thus while the arcs along the quadrant marked are equal, and therefore accurate, the parts marked *m*, *n*, *o*, *p*,

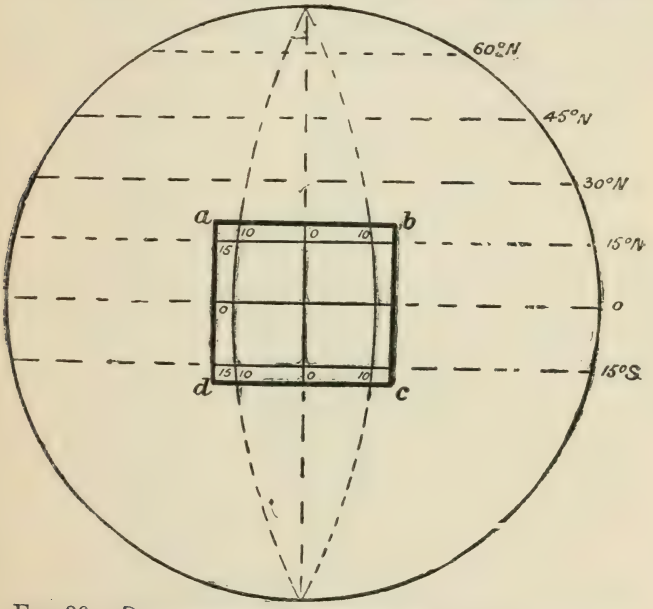


FIG. 36.—DIAGRAMMATIC FRAGMENT OF AN ORTHOGRAPHIC PROJECTION.

etc., along the middle meridian gradually diminish from equator to pole, and the inaccuracy is a maximum along this meridian (Fig. 34).

Thus representations of countries near the poles are compressed along the N.-S. direction. It follows from

(*a*) W.-E. compression near the edge of the map

(*b*) N.-S. „ „ poles on the map,

that (1) distortion of shape is most at the extremities of the

semi-equator shown; (2) diminution (but not distortion) is a maximum in high latitudes.

[*The student should contrast this projection with Mercator's, which exaggerates the polar areas very considerably.*]

Orthographic Polar Map.—This projection is seldom used. If the middle point of the circle be taken as the North Pole, the meridians of longitude would appear as radii of the circle.

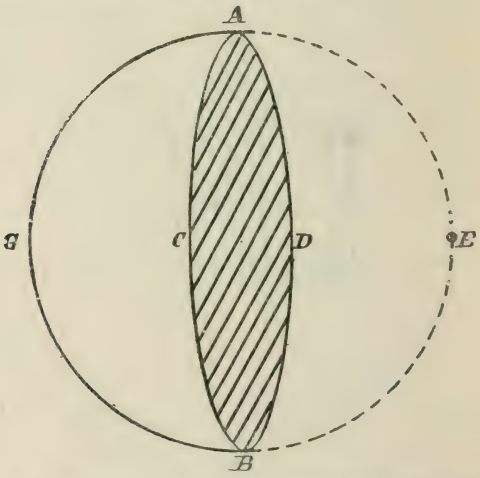


FIG. 37.—EXPLANATION OF STEREOGRAPHIC PROJECTION.

The parallels of latitude would be concentric circles, distance between any two parallels diminishing towards the equator.

The student should find it a useful exercise to state the distortions and diminutions of scale on such a map (Fig. 35).

A small section taken near the centre of an ordinary orthographic map would be fairly accurate (*see* Fig. 36).

2. **The Stereographic Projection** represents one hemisphere as seen from the middle point on the surface of the other hemisphere, *i.e.*, the eye is brought from an infinite distance

to a point on the opposite side of the sphere, to which point all rays from points on the hemisphere to be projected converge.

Suppose AGB (Fig. 37) a glass hemisphere with half the world mapped on it. Let ABCD be a circular *transparent flat* (say glass) *surface*. How would the features marked AGB appear on the transparent plate ABCD to an observer

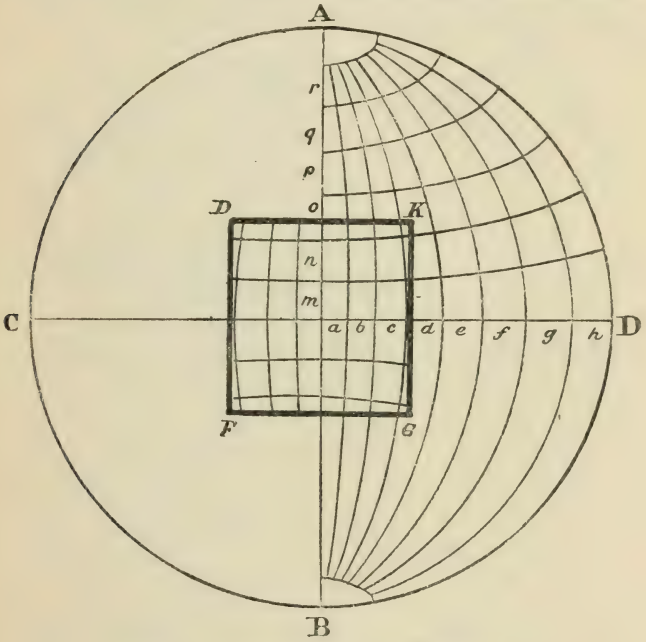


FIG. 38.—STEREOGRAPHIC PROJECTION.

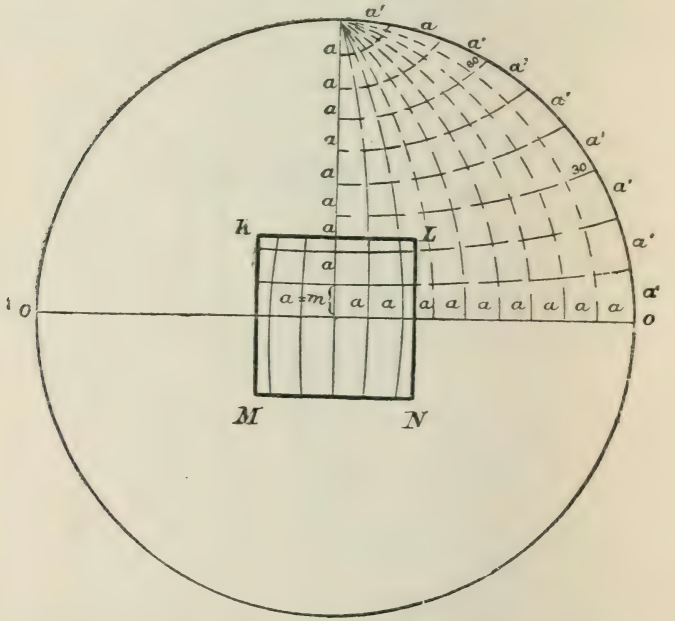
at E? The resulting figure is a stereographic projection. The student may work out the general effect of such a projection. (*See* Fig. 38.)

(*a*) Magnification (E.-W.) towards the edge of the map.

(*b*) Magnification (N.-S.) in polar regions.

A section near the middle of the circle would fairly well represent the surface (Fig. 38).

3. **The Equidistant or Globular Projection.**—If the eye be neither at an infinite distance nor on the surface of the sphere, but somewhere between—*i.e.*, outside the sphere—we naturally obtain a projection differing from either the Orthographic or the Stereographic projection, and to some extent correcting their errors of representation, for where the one distorted by magnification the other did so by diminution. Such a pro-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Stereographic. Of course it does not give *true* form and size, for if it did, a would equal a', each being 10° of a great circle. But geometrically $a=\frac{1}{18}$ of the line $OO=\frac{1}{18}$ of the diameter,

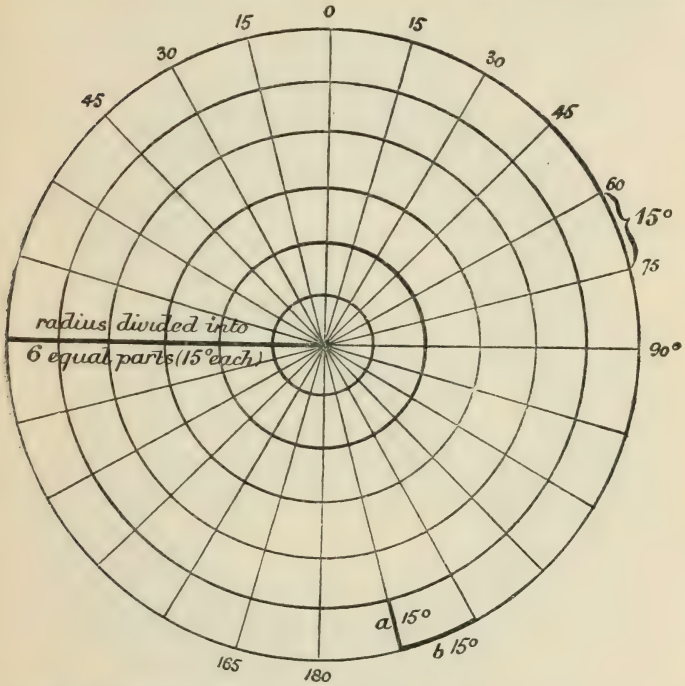


FIG. 40.—EQUIDISTANT POLAR PROJECTION (Showing intervals of 15°).

i.e., $\frac{1}{9}$ (or $\frac{7}{63}$) of the radius, whereas $a'=\frac{1}{9}$ of a quadrant, *i.e.*, $\frac{1}{36}$ of a circle, *i.e.*:—

$$\frac{1}{36} \text{ of } 2\pi r = \frac{1}{36} \text{ of } 2 \times \tfrac{22}{7} \times r = \tfrac{11}{63} r.$$

$$\therefore\ a\ :\ a'\ ::\ \tfrac{7}{63}\ :\ \tfrac{11}{63},\ \textit{i.e.},\ 7\ :\ 11.$$

On a globe $a=a'$.

Near the centre this map is very accurate (*e.g.*, KLMN), for $a=m$, both being representations of 10° on a straight line.

A **polar projection** on the **equidistant** plan would be made up of radiating straight lines representing meridians and cutting the equator at equal intervals with *equidistant* concentric circles for lines of latitude (Fig. 40).

In Fig. 40 the radii are cut up into six equal parts of

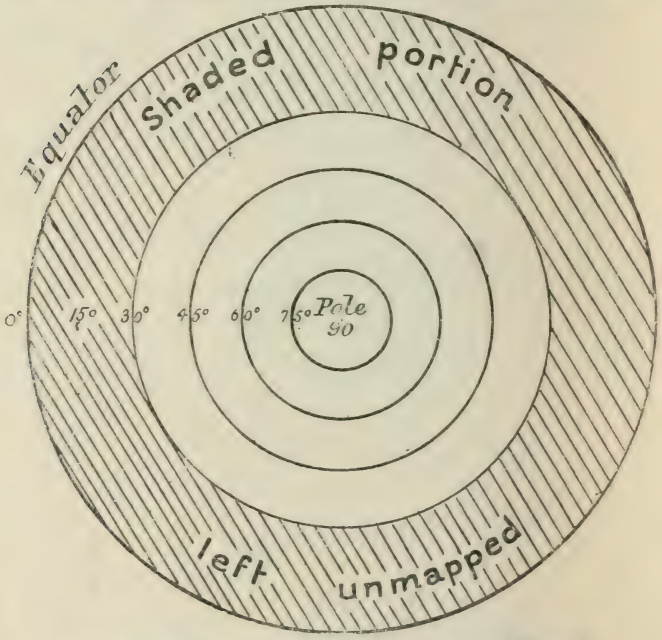


FIG. 41.—EQUIDISTANT POLAR PROJECTION (*Postel*).

15° (=90°) by the equidistant concentric circles. The student will see that $a=b$ on a sphere, but on this projection

$b=\frac{15}{360}$ of the circumference. $a=\frac{1}{6}$ of radius.

$=\frac{1}{360}$ of $2\pi r$ $a=\frac{1}{6}r$

$=\frac{\pi r}{12}$ $=\frac{r}{6}$ or $\frac{2r}{12}$.

$\therefore b : a :: \pi : 2$

$b : a :: 3{\cdot}1416 : 2.$

i.e. b is 1·57...times as long as a on the flat projection.

Thus the distortion is considerable along the outer edge of the map, and it is a distortion in longitude E.-W.*

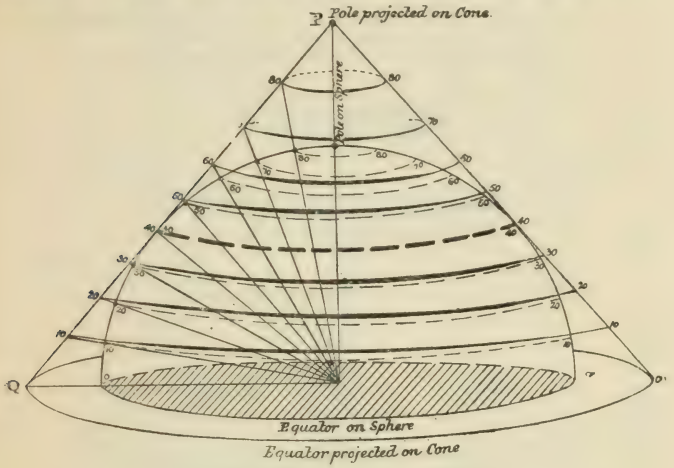


FIG. 42.—CONICAL PROJECTION.

4. One of the most popular forms of map projection is the **Conical Projection** (*see* Fig. 42). A hemisphere is projected

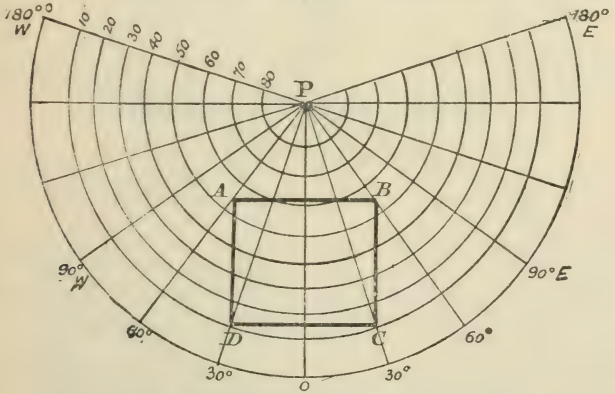


FIG. 43.—RESULT OF CONICAL PROJECTION.

upon an enveloping cone PQO, whose surface is tangential to that of the sphere along a parallel of latitude (40° say). The

* Fig. 41 shows how this can be overcome.

parallels on the sphere are dotted circles. The projected parallels on the cone are continuous-line circles. If the surface of the cone be opened out flat it becomes a segment

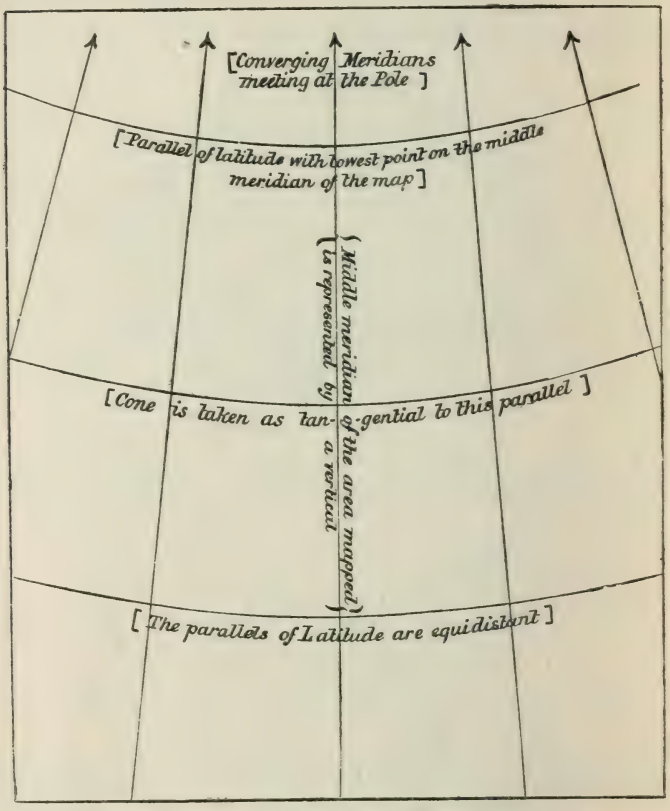

[Converging Meridians meeting at the Pole]
[Parallel of latitude with lowest point on the middle meridian of the map]
[Middle meridian is represented by a vertical]
[Cone is taken as tangential to this parallel of the area mapped]
[The parallels of Latitude are equidistant]

FIG. 44.—EXAMPLE OF CONICAL PROJECTION.*

of a circle, as shown in Fig. 43. The arc of the segment is equal in length to the circle representing the equator projected on the cone. The radius of the circle is equal to PQ. Now

* A modification of this gives curved lines of longitude. (*See* "The World.")

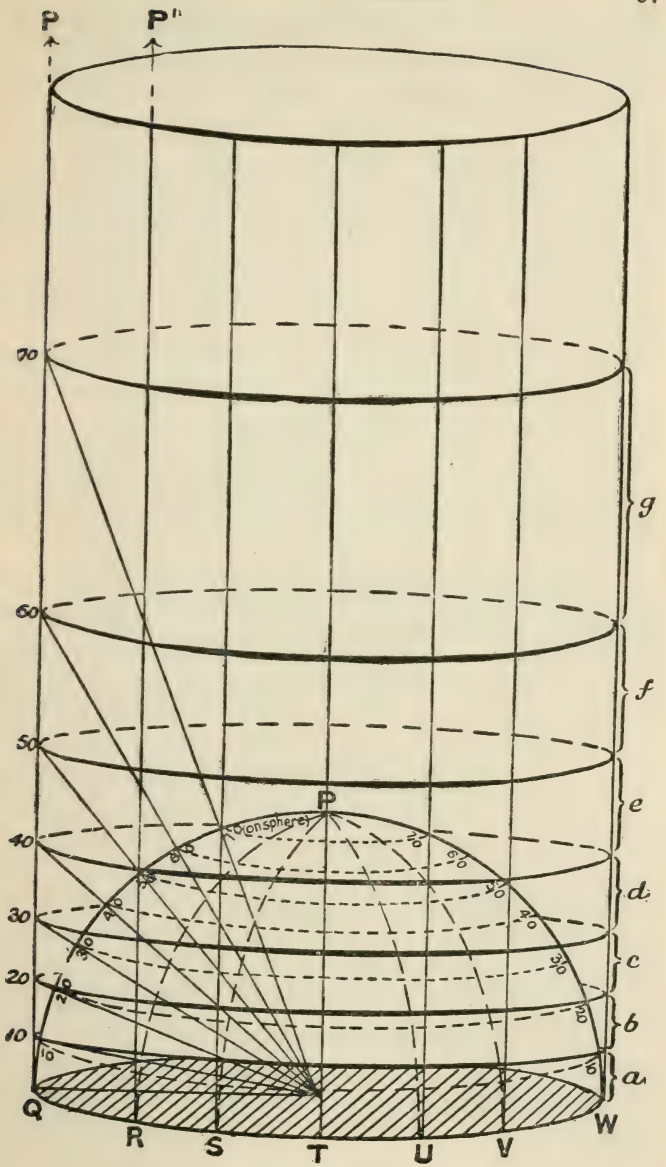


FIG. 45.—CYLINDRICAL PROJECTION.

PQ is about $\frac{3}{4}$ the diameter of the projected equator, *i.e.*, projected equator has diameter $\frac{4}{3} \times$ PQ (roughly).

$\therefore$ projected equator $= \frac{22}{7} \times (\frac{4}{3} \times \text{PQ})$

$= \frac{88}{21}$ PQ, or roughly 4 times PQ,

i.e., curve $= 4 \times$ radius. This is very advantageous, for a radius on the map (Fig. 43) represents a quadrant (90°) on a sphere, and the arc a great circle (360°). Thus a hemisphere projected would be represented on a flat map as shown in Fig. 43.

In practice a portion of a hemisphere is shown, say the area ABCD.

To obtain the meridians and parallels, the arc is divided into 360 equal parts and the radius PQ is divided proportionally to the line PQ in Fig. 42.

The reader will see that the circles are not equidistant; both towards the equator and poles some exaggeration occurs. In the region of the tangential parallel the results are very accurate.

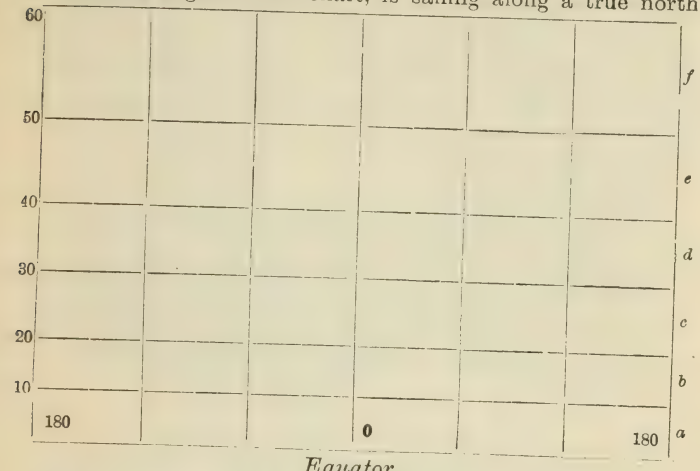
5. A projection of special value to navigators is the **Cylindrical Projection,** though it is more commonly used in the modified form suggested by **Mercator** about 1570.

The sphere is projected upon an enveloping cylinder, the line of contact being the equator. The projected meridians become parallel vertical lines; just as QP becomes QP′, so RP becomes RP″, etc. The circular parallels of latitude on the sphere are projected as circular parallels of latitude upon the cylinder, but at unequal distance, the exaggeration becoming excessively great in high latitudes.

When the cylinder is cut along one of the vertical meridians it opens out as a flat oblong sheet, on which the parallels of latitude become straight lines, which for part of a hemisphere appears something like Fig. 46, the spaces *a*, *b*, *c*, *d*, etc., being unequal as we move away from the equator.

The great advantage of such a map is that it shows the *true direction* of one place with regard to another. Thus. in

Fig. 47 *a* is due north of *b*, and *c* is due east of *a*. Sailing along a line which on the chart is parallel to NS or N'S', or the parallel edges of the chart, is sailing along a true north



Equator.

FIG. 46.—SKELETON MAP ON THE CYLINDRICAL PROJECTION.

or south track, whilst sailing at right angles thereto means sailing along a true east or west direction.

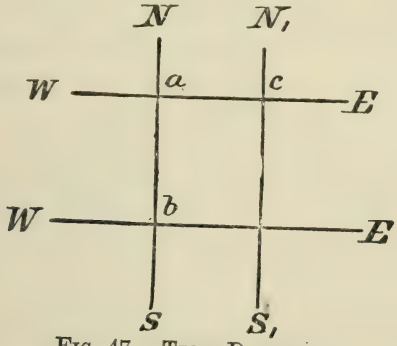


FIG. 47.—TRUE DIRECTION.

The exaggeration of scale is so enormous in high latitudes as to give great exaggeration of area together with great distortion of form.

Mercator's map is a modification, which greatly reduces the distortion in latitude, especially in high latitudes (say over 45°).

It is clear that Mercator's map cannot be used for measurements of length or area. The reader is warned against its exaggeration of areas in high latitudes.

Given any projection, if we have the necessary co-ordinates of any given place, viz., latitude and longitude, it becomes easy to mark its position upon the map, and so indicate its position relative to other places upon the earth's surface.

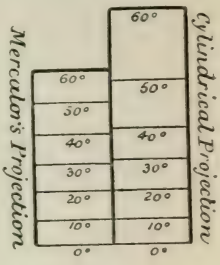


FIG. 48.—COMPARISON OF MERCATOR'S WITH SIMPLE CYLINDRICAL PROJECTION.

CONTOURED MAPS.

In addition to projecting a spherical surface upon a flat map, it is necessary to have some method of representing heights and depressions of the earth's crust. The most satisfactory method is by means of bathy-orographical maps, now coming into general use, though the general idea is by no means new.

Contours and Sections.—The method is to plot upon the map *loci* of places standing at the same elevation in reference to sea-level, which is taken as a datum line. Such loci are called contour lines. On the map of a continent heights varying by 500 feet are usually shown, since the scale is too small to allow of more lines without obscuring the map. On the map of a county or a river basin the scale is sufficiently large to allow contour lines representing differences of altitude as small as 100 feet to be shown.

The general principle of contour lines and their uses may be made clear by reference to some simple illustration.

N.B.—In Figs. 49 to 62 thick lines are used for clearness; on survey maps the lines are very fine (see Fig. 63).

Let the four lines in Fig. 49 represent contours of 0 ft. (sea level), 50 ft., 100 ft., and 150 ft. respectively. It will be seen that in travelling from *a* to *d* we rise 150 ft., and since the contours are practically equidistant, the rise is uniform up

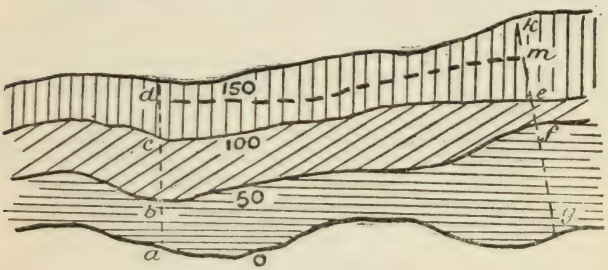
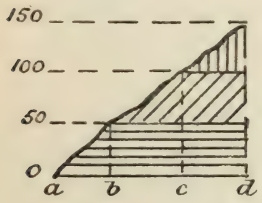
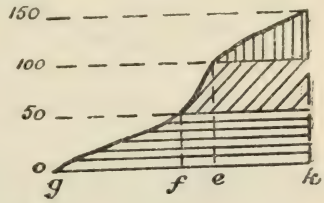


FIG. 49.—SIMPLE CONTOUR MAP.

a gradual slope. Travelling along *dm*, we nowhere rise above 150 ft. or descend below 100 ft. so that the track is almost a level one. The slope from *k* to *g* differs from the slope *d* to *a* in being irregular. Thus from *k* to *e* is a more gradual slope than from *d* to *c*, since to fall 50 ft. we must traverse more ground (*ke* > *dc*); from *e* to *f* is a sudden descent of 50 ft.





FIGS. 50 AND 51.—SECTIONS ALONG *ad* AND *gk* OF FIG. 49. (*abcd* and *gefk* are drawn to scale of Fig. 49.)

more, whilst *f* to *g* is another gradual slope to sea-level. Figs. 50 and 51 illustrate the difference and represents sections along *ad* and *gk* respectively. *abcd* and *gfek* are marked off

along a horizontal scale, whilst altitudes are placed along a perpendicular scale. The dotted perpendiculars correspond to heights. The vertical scale is not the same as the horizontal scale, but grossly exaggerated of necessity, since surface-elevations are small compared with horizontal distances. The length of a continent may be several thousand miles, the height of the highest mountain is only some five miles.

Figs. 50 and 51 teach us—

(*a*) That parallel contours suggest a slope more or less uniform.

(*b*) Departures from parallelism indicate divergence from uniformity of slope, wide spaces pointing to gradual slope, narrow intervals indicating steep slope.

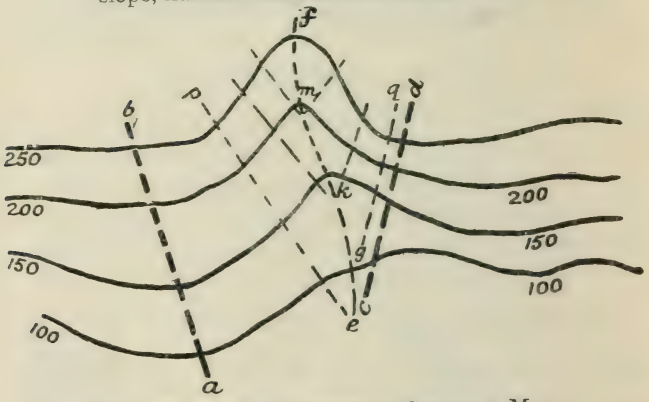


FIG. 52.—MORE DIFFICULT CONTOUR MAP.

Fig. 52 illustrates a divergence from the regularity of the features represented in Fig. 50 and 51.

The student will recognise that *ab* represents a fairly uniform slope, and *cd* a less uniform and steeper slope. It remains to discover what the bend in the lines indicates. Each of the dotted lines (normal to the curve at different points) is a slope, more or less uniform. The dotted line *ef* represents at each point the lowest point of the slope; but

e, *g*, *k*, *m* and *f* represent higher points along the locus *ef*. It is evident that the figure represents a valley whose mid-rib is *ef*, with source of stream (if any) at *f*, and whose outlet is at *e*. The dotted lines indicate the slopes of the valley towards the mid-rib or *river-course*. Such features are common on contour maps.

But we must now consider what the lines would represent if the numbers were reversed. The student will at once see that the bends in the contours represent a *projecting hill* (or spur) instead of a *receding valley*. *ab*, *cd*, *ed*, and *gd* are all ascending slopes.

A third diagram, Fig. 54, shows part of a rid e, for we

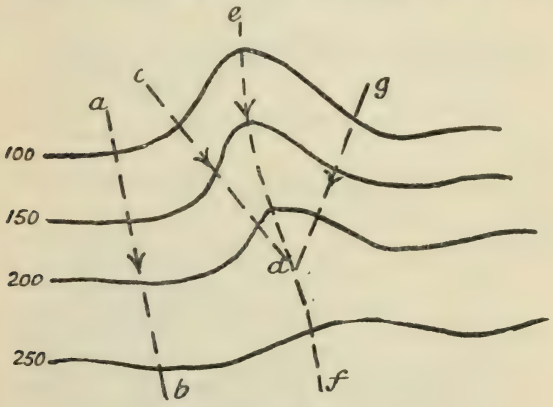


FIG. 53.—A SPUR.

ascend from *a* to *b* or from *c* to *b*. To walk along the line *mn* would be to walk along the ridge of the range.

Fig. 55 is evidently the diagram of a hill or mountain, for from whatever point of the compass we approach *x*, we are ascending a slope, as indicated by the arrows; *yx* is evidently a steep slope, *zx* a gradual slope. Below we give a section along *yz* (Fig. 56). The vertical scale is, of course, grossly exaggerated. Fig. 57 represents the hill, with same horizontal scale, but with vertical scale diminished by half.

The lines in Fig. 55 would represent a depression, if they were marked fathoms, *i.e.*, depths below sea level, as in Fig. 59.

A depression on land would have smaller numbers for the inner contours, whereas a depression in the ocean has larger numbers (Fig. 58).

The great variety of contour-forms occurring on maps especially of hilly regions, is simply an aggregate of the simple forms discussed above. Thus Fig. 60 represents one

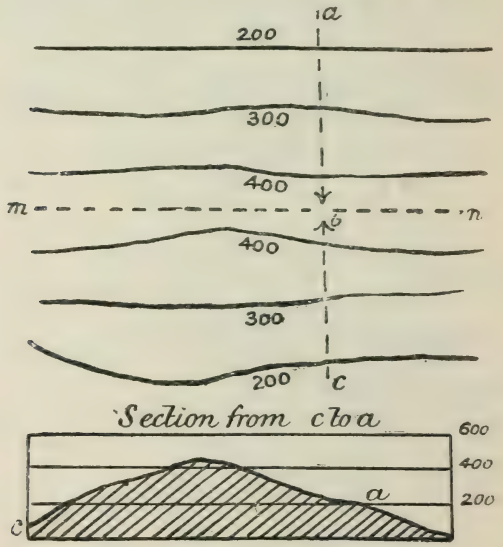


FIG. 54.—A RIDGE.
(a and c should be below the 200 line.)

hill surmounted by two hillocks, that is, a hill with two summits, or peaks, one higher than the other.

The student should draw a section along *ab* in order to realise it. Between the two summits is evidently a hollow, or valley or pass, for from *z* it is an ascent to either *x* or *y*; but *z* is at considerable altitude, being higher than 250 feet, and somewhere just below 500 feet. It therefore represents

a hill-gap, or a saddle. Such a figure on a mountain of Alpine altitude would represent a mountain pass.

The palmate or digitate arrangement shown in Fig. 61

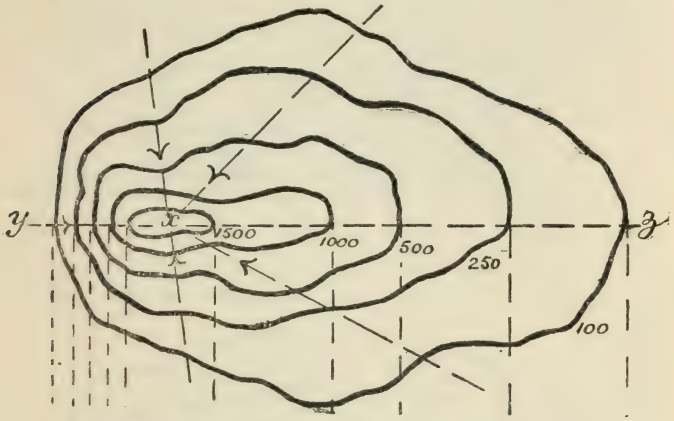


FIG. 55.—CONTOURS OF A HILL.

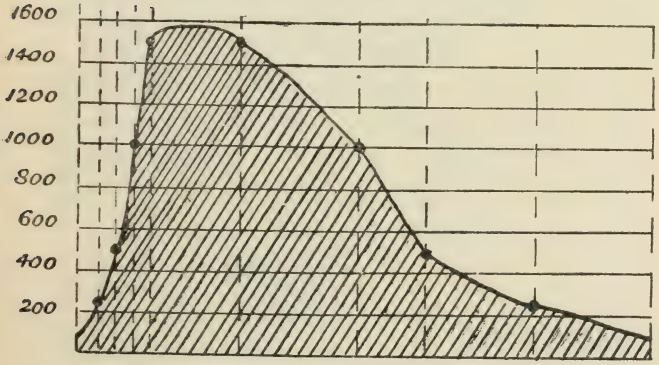


FIG. 56.—SECTION ALONG *yz* OF FIG. 55.

is simply an aggregate of bends similar to that shown in Fig. 52 and represents a series of converging valleys such as give convergent tributary streams.

One more example shall suffice. Fig. 62 represents a tableland with **radiate valleys.** Streams are inserted to indicate the valleys, and arrows point the direction of flow of the streams.

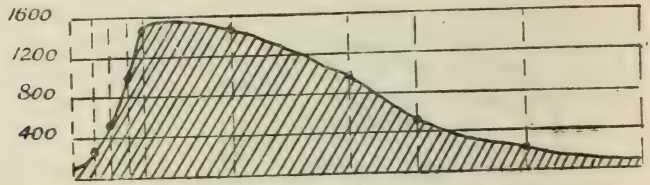


FIG. 57.—VERTICAL SCALE HALF THAT IN FIG. 56,

On maps of small scale contour lines are apt to become crowded and confused. Such is the case in atlas and cycling

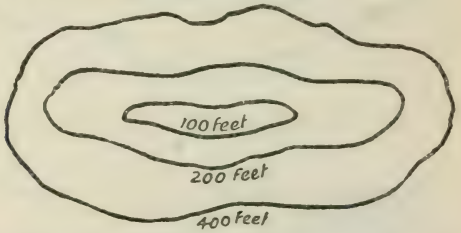


FIG. 58.—DEPRESSION—ON LAND ABOVE SEA-LEVEL.

maps. To avoid this, the spaces between the contour lines are coloured in such a way as to indicate altitude. (See

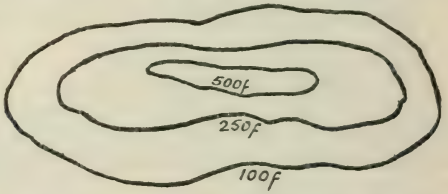


FIG.—59—DEPRESSION—AT SEA BELOW SEA-LEVEL.

Newnes's Atlas and Bartholomew's reduced cycling maps. Those of North Wales, the Western Highlands and the English Lake District are very instructive.) Deep green

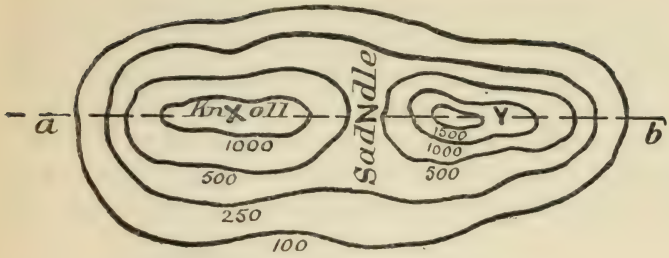


FIG. 60.—SADDLE BETWEEN TWO KNOLLS.

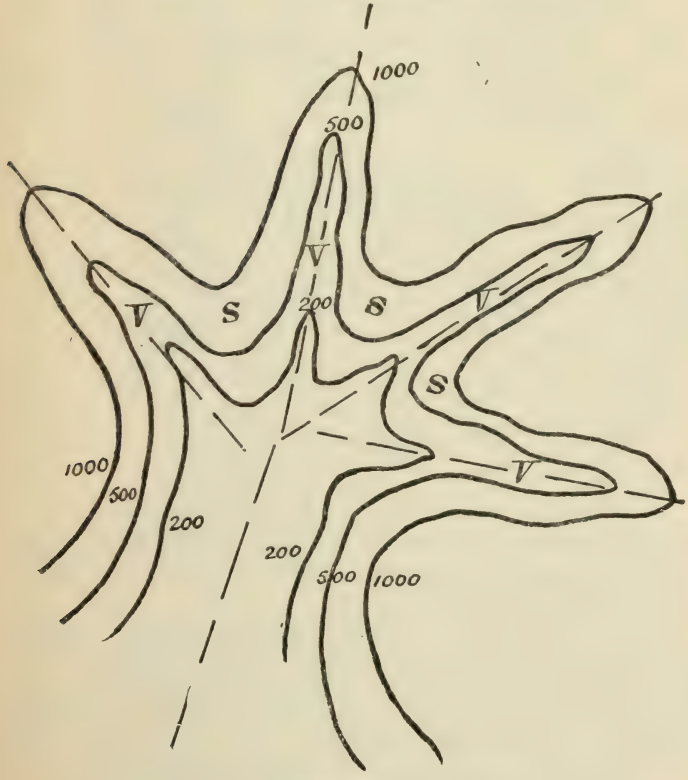


FIG. 61.—CONVERGENT VALLEYS.

is used t represent the low-lying belt of country, dark brown to represent the highest altitudes on the map. Between these two extremes the colours shade off towards each other in pale brown and pale green.* The student is warned that the same shade of brown does not usually stand for the same altitude or different maps, and the same is true of the green belts. In every case reference must be made to the key

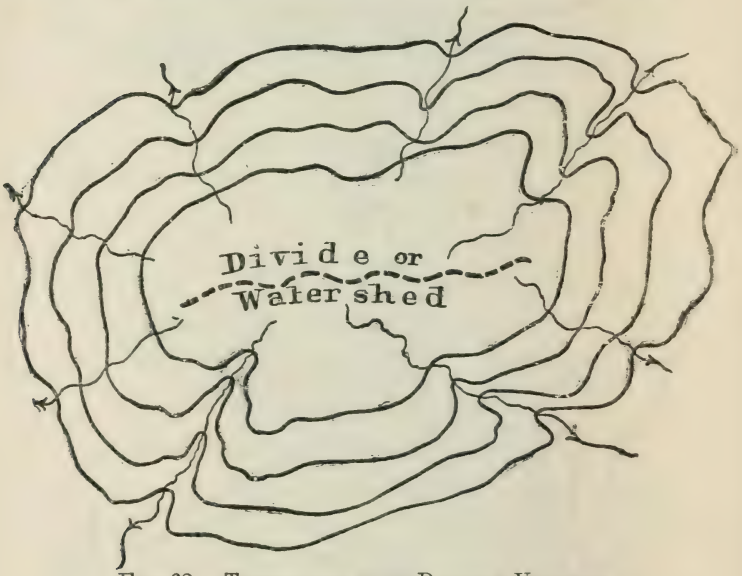


FIG. 62.—TABLE-LAND WITH RADIATE VALLEYS.

diagram inserted in the corner of the map; but browns are reserved for altitudes and greens for low-lying areas. (*Cf.* shading used in Figs. 50 and 51.)

Maps so coloured are called **orographical maps.** Maps showing ocean depths by depression contours—pale blue for shallow waters graduating through to deep blue for the deepest waters—are **bathymetrical maps.** Maps combining both

* Mackinder's Wall Maps and Elton's Atlas use only shades of brown.

Dodderham Moss
Guilmire
Kirk Bank
Blackmire
Pikes Edge
Pike Moss
Broad Side
Marble Works
Low Laithaw Moss
Bank Side
Dee Side Moss
Scale Gill Force Moss
Stick Snaize
Wild Fell
Wild Fell Beacon
Newby Head
Newby Head Moss
Stone Moss
Gayle Moor
Black Rake
Rough Gill Brows
Wheneside Tarns
Broadmea Head
Cowgill Wold Moss
Shaking Moss
Middale Little Tarn
Middale Great Tarn
Monkenbeck Grain
Green Gear
Coppleth waite
Bourne
Kirk Bank
Guythorn
Dent
Deepdale
Flatt or Stone Hill
Outrake Foot
Sure Garth
Crag Hill
Middle Head
Rise Hill
Rough Hill
Bleaberry Fell
Bleaberry Moss
Bleaberry Gill
Bleaberry Tarn
Bleaberry Combe
Bleaberry Hill
Bleaberry Moor

orographical and bathymetrical features are called **bathy-orographical maps.**

The student should familiarise himself with the following maps of his own district:—

1. Cycling map orographically coloured, on a scale of two miles to the inch.

2. Ordnance maps of home district on the scale of one mile to the inch. Contour lines are often very difficult to trace, being very faint dotted lines, with altitude in feet marked here and there. One-inch maps with contours in red can now be purchased. A pocket lens is useful in tracing such lines. (Ordnance maps can be purchased through the Post Office.)

3. The six-inch map of his immediate surroundings.

To the intelligent student these maps speak for themselves, especially when they represent the home district. An example of the one-inch map is given in Fig. 63. The student should draw sections along AB and CD.

Attention is called to the **facts that can be learned from a bathy-orographical map of the world:—**

1. The mountain ranges of the New World run north and south, close to the Pacific Border; those of the Old World trend eastward and westward in Eurasia, with a lateral branch running north and south along the Indian Ocean border of Africa.

2. The Atlantic side of both *American* continents is characterised by a series of depressions, the Hudson Bay and the Mississippi depressions in North America; the Amazon and the Plate Valleys in South America. Minor ranges are the Alleghanies of North America; minor plateaux are the Great Basin of the Colorado, and the Columbia plateau, forming an expansion of the Rockies in North America, and the broad plateau of Brazil separating the two depressions of the South American continent.

3. *Europe* lies, on the whole, much lower than Asia; the continent is remarkable for its many submerged sea-filled depressions—the White Sea, the Baltic, the British seas, the three sections of the Mediterranean, and the Euxine seas. North *Asia* is low-lying; Central Asia is the "roof of the world," a series of plateaux cut off from each other by mountains of more than Alpine altitude. Lower plateaux occupy the countries of Arabia, Persia and Afganistan, as well as the Deccan of Peninsular India.

4. *Africa* and *Australia* present many resemblances to one another, and contrasts to the remaining continents. Plateaux predominate over ranges, and low-lying depressions are few. Sea-filled depressions are conspicuously absent, resulting in a poverty of harbours, especially in Africa.

5. The *Atlantic* is a long trough between the Old World and the New, divided below the surface into western and eastern basins by a middle ridge running its entire length.

6. The *Arctic* is shut off from the Atlantic by a transverse submarine plateau, portions of which emerge in Iceland and Greenland.

7. The *Pacific* is a broad expanse of ocean with transverse ridges rather than longitudinal (as in the Atlantic). It covers quite one-third of the surface of the globe.

8. The *Antarctic* is a shallow ocean engirdling a Southern Polar Continent; of it the *Indian* Ocean may be considered a deeper branch in warmer latitudes.

EXERCISES ON AREAS.

1. *The student should be able to estimate roughly the area of a river basin or of a province, if a map* with a scale *is given to him.*

The outline of the province is marked. In the case of a river basin it is necessary to draw the boundary of the basin by reference to lines of drainage.

When the area to be measured is defined, it should be covered with squares of $\frac{1}{10}$ in. side. Then, by taking the sum of the whole squares and fractions (approximately estimated) included within the irregular area, say:—

9 whole squares $+ a + b + c + d + e + \ldots$

$= 19{\cdot}3$ whole squares.

Suppose 1 in. = 4 miles, then $\frac{1}{10}$ in. = $\frac{4}{10}$ ml.

Area of one whole square = $\frac{4}{10} \times \frac{4}{10} = \frac{16}{100} = {\cdot}16$ sq. mls.

„ river basin $= 19{\cdot}3 \ldots \times {\cdot}16$ sq. mls.

If transparent squared paper is available, the basin may

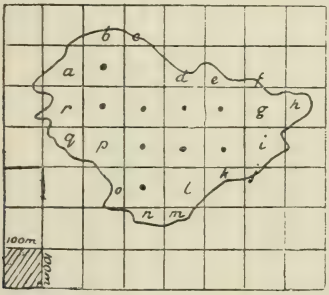


FIG. 64.—EXERCISE IN AREA-MEASUREMENT.

be traced thereon.* Thick lines lead to inaccurate results. Estimates may be tested by reference to cyclopædia.

2. Find in round numbers the areas of Great Britain, France, Germany and Russia. Compare with cyclopædia. (See Fig. 65.)

In this diagram we have a graphic comparison of the respective areas of Russia, Germany, France and Great Britain. Each square has a 100-mile side, and, therefore, an area of $(100 \times 100) = 10{,}000$ sq. miles.

* Excellent transparent squared paper may be had from Messrs. Jackson Armley, Leeds; or Stanford's, Long Acre, London.

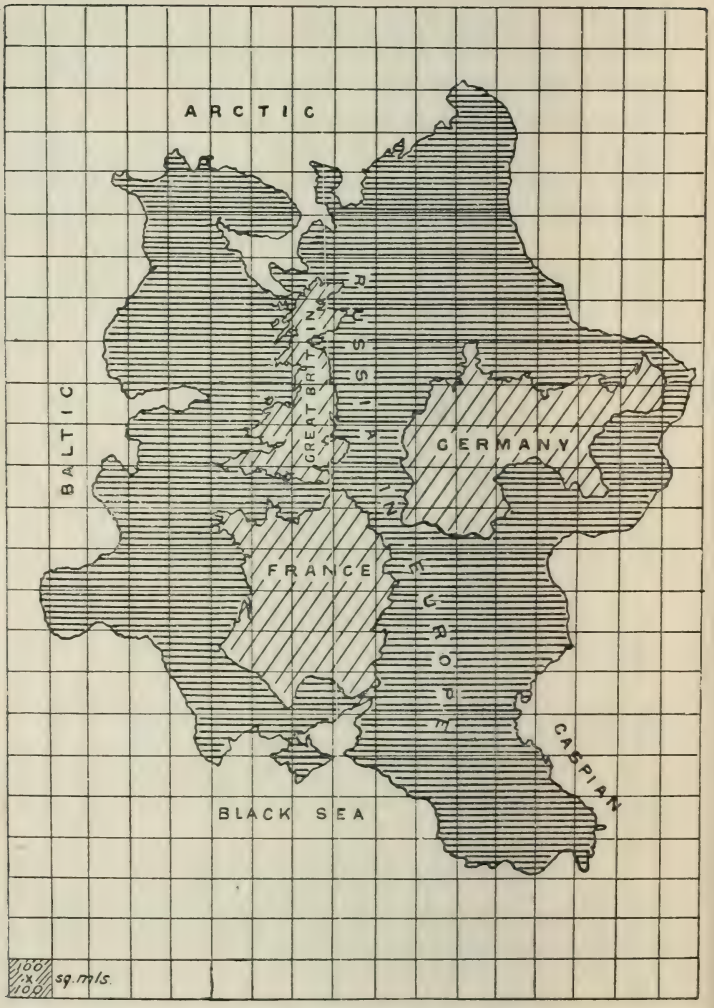


FIG. 65.—COMPARATIVE AREAS.

CHAPTER IV.

The Earth's Crust; Broad Outlines of Physical Geology. The Bearing of Geology upon Geography.

[Maps to be studied: Geological Maps of the Continents; Geological Map of the British Isles; Orographical Maps of the Continents.]

The Earth's Crust.—The outer shell of the Earth is called by geologists the earth's crust. It is that part of the globe upon which we can make *experimental observations*. Within it exists the great unknown ball of the Earth about which we can only make inferences from known astronomical and physiographical facts. The thickness of this crust may be taken to be less than 10 miles or $\frac{1}{400}$ of the earth's radius. It is a well-known fact that the temperature increases at a rate of something like 1°F. for every 60 feet of descent into the earth's crust. Assuming that the temperature increases, however slowly, as we probe towards the centre of the Earth, it is quite clear that not many miles below the crust we should come to a point at which the temperature would be as high as the melting-point of any known rock. If so, it remains to consider whether the earth's interior is liquid or solid. Scientists believe that the rocks are not actually, but *potentially* molten. They exist under *great pressure*, which prevents their liquefaction, although the necessary conditions of temperature are fulfilled. Once let the pressure be diminished, and the potentially molten

material becomes actually so. This accords with our knowledge of the earth's stability much better than the older theories of a liquid interior, and it agrees too with our modern knowledge of volcanic and seismic phenomena. (See below.)

The increase of temperature as we pierce towards the earth's core suggests that our Earth is a *cooling sphere.* A cooling globe will contract upon itself and thereby set up *stresses and strains* in the outer crust. Such stresses give rise to *seismic** *phenomena*—earth-tremors, earthquake fractures, and, in extreme cases, to *volcanic eruptions.*

Seismic and Volcanic Phenomena.—If an earthquake be of such violence that a fissure deep enough to reach the potentially-molten rocks is opened, the result is a volcanic outpouring. If the fissure be insignificant, only earthquake phenomena are experienced. The rocks of the earth's crust are more or less saturated with water. Under high temperatures and great pressures within the crust, this water is only *potential'y* steam, but following upon a deep fissure opening as the outcome of an earthquake, it flashes into super-heated steam of tremendously high temperature and explosive force. Hence it is that in an *eruption* the first outburst from the crater is a rush of steam, often rising 10 miles into the air. The potentially molten rocks liquefy, and are simultaneously carried up by the explosive steam into the air to descend in a red rain of stone drops.

The quantity and the temperature of the *steam* present determine the nature of the eruption. A violent eruption is an outcome of much pent-up steam. The molten rain falling around the volcano cools and solidifies to form *volcanic ash,* which may be carried many miles from the crater. A quiet eruption is characterised by the presence of much less steam and the lava wells over the side of the crater precisely like porridge boiling over the side of a pan. *Ash-eruptions* are therefore more violent than *lava eruptions.* An old *earth-*

* Gk.: *seismos*=a tremor.

FIG. 66.—LOCI OF VOLCANIC AND SEISMIC ACTIVITY.

quake fissure never quite heals up, and as a result, such a fracture line becomes a *line of volcanic activity.* The student should trace on a map of the volcanoes of the world the dominant lines of disturbance and eruption. Earthquakes of a mild nature often occur, of course unaccompanied by

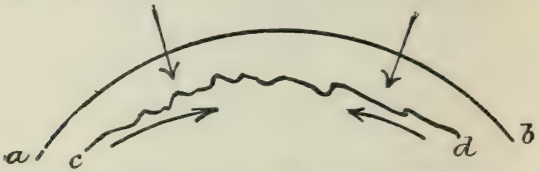


FIG. 67.—CRUMPLING DUE TO CONTRACTION.

volcanic outbursts. The relation of *seismo-volcanic* lines to the *trend of the world's mountain chains* deserves special attention. With few exceptions it is found that lines of volcanoes run along the *sea-ward flanks* of lofty mountain ranges. The *process of mountain-making* seems therefore bound up with seismic and volcanic phenomena. Indeed, the prime result of stress and strain in the earth's crust may be taken as mountain-making, of which earthquakes and

FIG. 68.—GENERALISED DIAGRAM TO ILLUSTRATE THE ARRANGEMENT OF ROCKS IN A MOUNTAIN UPLIFT.

volcanoes are the accompaniments. Any segment of the crust, such as *a b* (Fig. 67) contracting, however slowly, to *c d*, must in the process suffer compression and crumpling. Fig. 68 is a diagram of the internal structure of a mountain chain.

The Structure of Mountain Chains.—The core of the range is *granitic* or *crystalline* in character: on either flank the strata next the granite are crushed or crumpled into *irregular folds*,

whilst those further from the core may be *symmetrically folded* and inclined towards the central core. Beyond these, on either flank and merging in the plain, are almost *horizontal* strata, unaffected by crumpling or folding forces, and therefore deposited after the close of the mountain-making process.

When we bore through the mantle of stratified rocks, even in the basins and on the plains of the continents, we invariably come upon crystalline unstratified rocks. The floor on which all sediments rest is therefore crystalline, and it seems probable that it is from this primeval crystalline floor that all sediments have been derived by denudation followed by deposition under water. In many regions these crystalline rocks are not covered by sediments (*e.g.*, Finland and Labrador).

Granites and lavas are crystalline rocks of a different type, having been up-thrusted from below, in the former case *into* overlying rocks, in the latter case *through* them, to flow out on the Earth's surface, where they have solidified on cooling.

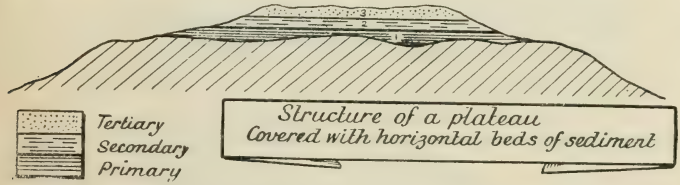


FIG. 69.—STRUCTURES OF A PLATEAU COVERED WITH HORIZONTAL BEDS OF SEDIMENT.

Crust-blocks.—A structure quite different from a mountain-system, yet giving rise to upland country, is the *crust-block*. *Crust-blocks* occur in areas where the crust has been fractured rather than crumpled. The fractures form irregular polygons on the surface. Imagine one of the polygons to remain standing whilst the adjacent polygons are more or less depressed after the fractures have been formed. Let the rate of depression be exceedingly slow. It is clear that the up-standing block of country will be sculptured by rain and frost,

so that its polygonal outline is in time obscured. Such a structure is a *crust-block*. Folding and crumpling thus give rise to *mountain systems*. Fracture and depression leave uplands of the *crust-block* type, and these are usually *plateaux*.

Other Forms due to Earth Sculpture.—Gentle folding and tilting give rise, under the modifying influences of denudation, to *hill country*, *rolling prairie*, and *escarpments*, of comparatively low elevation. When strata are thrown into gentle folds, as in the Thames Basin, they form *synclines* (troughs) and *anticlines* (arches).

FIG. 70.—SYNCLINE AND ANTICLINE.

Anticlines are most exposed to denudation, with the result that they often present the appearance of basins. Indeed,

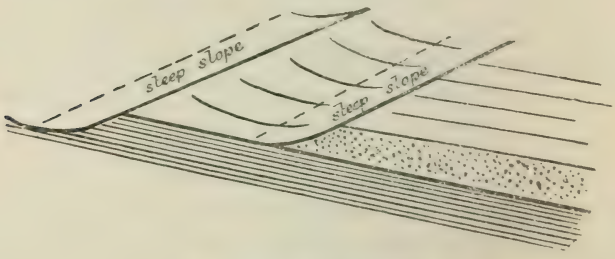


FIG. 71.—ESCARPMENTS.

we may get a basin upon an elevated anticline, like the weald of Sussex and Kent. The weathered edge of the strata overlooking the basin forms an *escarpment*. Thus, in Fig. 71, the escarpment of the North Downs faces S.E., whilst that

of the South Downs faces N.W. Escarpments are common hill-forms in areas of gently-tilted strata. The diagram, Fig. 71, will illustrate the general idea of an escarpment, and Fig. 71B gives a

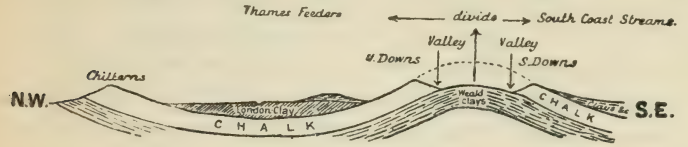


FIG. 72A.—SECTION ACROSS THE CHALK RIDGES OF THE SOUTH-EAST OF ENGLAND.

section across two parallel escarpments, those of the familiar Cotswold and Chiltern Hills. It will be seen from Fig. 72 that an *escarpment* is the more or less steep terminal face of a tilted stratum. Broad open *plains* are characterised, as a rule, by almost horizontal strata.

FIG. 72B.—SECTION ACROSS THE COTSWOLDS AND CHILTERNS.

Basalt Plateaux and Hot Springs.—In addition to the folded ranges, crust-blocks, scraped ridges, anticlines and synclines, plateaux and plains built of horizontal tabular strata, as well as chains of volcanoes, there remain *exceptional physical features* deserving separate consideration. Such are

FIG. 72C.—SECTION ACROSS ENGLAND.

the *basaltic plateaux* of the Snake River district of Columbia, Iceland, Antrim, the Middle Zambesi country and the Deccan of India, and the *hot-spring regions* of the Yellowstone River, Iceland and North Island, New Zealand.

These features are both volcanic in origin. Basaltic* plateaux are built up by *fissure-floods* of liquid lava, *upwelling* through a fracture in the crust, and spreading for miles on either side of the opening. The *absence of steam* in any great quantity accounts for the absence of volcanic cones. *Geysers* (or hot-springs) are really *feeble volcanoes* pouring out water instead of steam and molten stone. The hot waters contain much mineral matter dissolved, the mineral being those of the strata through which the water has passed. A pile of *deposited material* forms a mimic cone around the mouth of the geyser. The material is called *sinter*, and is, of course, deposited *from solution*. The famous white-and-pink terraces of Rotamahana, New Zealand, were deposits of sinter left by the water flowing down the terraces of a hill-slope.

Basalt plateaux may be built up of *several* flows, and so attain a great thickness. That of the Snake River (Western States of America) is nearly a mile in thickness and covers many hundreds of square miles.

Geology and Scenery.—The student will be prepared to notice the *effect of geological structure upon scenery*. Hard rock and soft materials have been exposed for ages to the *sculpturing action* of rain and frost, sun and wind. *Denudation* of uplands has been followed by *transport* of materials to lower levels. Earth sculpture has been modified by *tillage* and other agricultural developments. The sea, too, has been at work along the coasts, leaching out the soft materials and leaving the hard resistant rocks to stand out as *headlands*, *stacks*, and *rocky islands*. The gradual subsidence of a continental shelf (Fig. 73) has allowed the sea to creep up the valleys, forming *fiord-like sea-lochs*, *loughs*, and *bays*, and converting mountain groups into off-lying *archipelagos* (*e.g.*, Western Norway, British Columbia, and South Chile.)

We have seen that the principal materials of strata are clays, limestones and sandstones, with many varieties. All

Basalt is a lava rich in iron.

are *simple in chemical composition* compared with the *crystalline rocks* or the intruded *granite* or the extended *lavas*. *Clays* are silicate of alumina; limestones are carbonate of lime. *Sandstones* are silica grains, cemented by iron oxide or other compacting material.

It is an interesting fact that the crystalline rocks contain *all the components* of the stratified rocks except water and carbon dioxide (H_2O and CO_2), the constituents of rain. It seems reasonable, therefore, to suppose that all sediments have been derived by the *action of rain upon the crystalline rocks* in early times and upon both crystalline rocks and existing sediments in later times. If this be so, the breaking down of complex materials into simpler constituents by the action of rain should yield simpler and yet simpler materials as we pass from ancient to recent sediments. Such is the case. The richest soils are those derived from the direct breaking up of complex crystalline materials; hence volcanic soils, de-graded by successive rains, afford very fertile country.

Denudation: Its Relation to Topography and Scenery.—The form of a country is the outcome of *geological structure* modified by *subaërial forces* like rain, frost and sun-heat, by marine denudation, and by subterranean forces issuing in volcanic outpourings.

Rain is slightly acid, having carbon dioxide in solution, and acts as a *solvent* upon rocks, especially upon the predominant mineral, *felspar*, in crystalline rocks, and upon *limestones*. As a result, much rock degradation ensues, and compounds of potash and soda, as well as carbonate of lime, are carried off, *in solution*, by streams. Even the parts which are not readily soluble crumble, owing to the solution of the *cementing materials*; these are carried *in suspension* to lower levels, by streams and rivers.

Frost effectively breaks down rocks, by expanding the

water in the joints and spaces in the rocks, and causing the mass to split along its joints.

Extremes of temperature between mid-day and midnight form a powerful modifying force in tropical deserts. Rocks heated greatly during the day contract rapidly after sundown, and the strain due to contraction splits large masses up into small blocks.

The Continental Shelf.—*Marine denudation* determines the *minor* irregularities of our coastline, *not the major ones.* To understand these, we must consider what is meant by a *continental shelf.* Let *ab* represent a section through ocean and continent at some imaginary point *C* on the sea coast.

It would seem, at first sight, that the continent ended at C, and the ocean began. I_1 and I_2 are off-lying islands, S_1, S_2 and S_3 are seas, or arms of the ocean. But a careful examina-

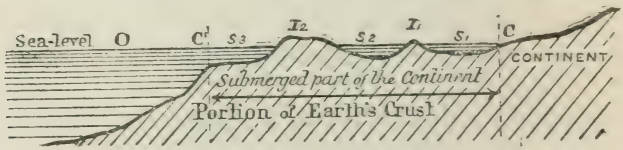


FIG. 73.—THE CONTINENTAL SHELF.

tion of soundings reveals that S_1, S_2 and S_3 are very shallow (say, less than 100 fathoms), compared with the open ocean, O (as deep as 2000 fathoms). Beyond C^1 the ocean deepens suddenly, say, 1000 fathoms in twenty miles. It will be evident that C^1 is the real *edge*, or *margin*, of the continent, the portion C^1C being a *submerged* extension of the continent, with its higher parts *emerging* as islands surrounded by shallow seas. Such submerged extensions are called the *Continental shelf*, and the islands thereon should be distinguished from *oceanic islands* by being called *continental islands.*

The *major irregularities* of the coastline will thus be seen to be *due to submergence* of an irregular continental surface,

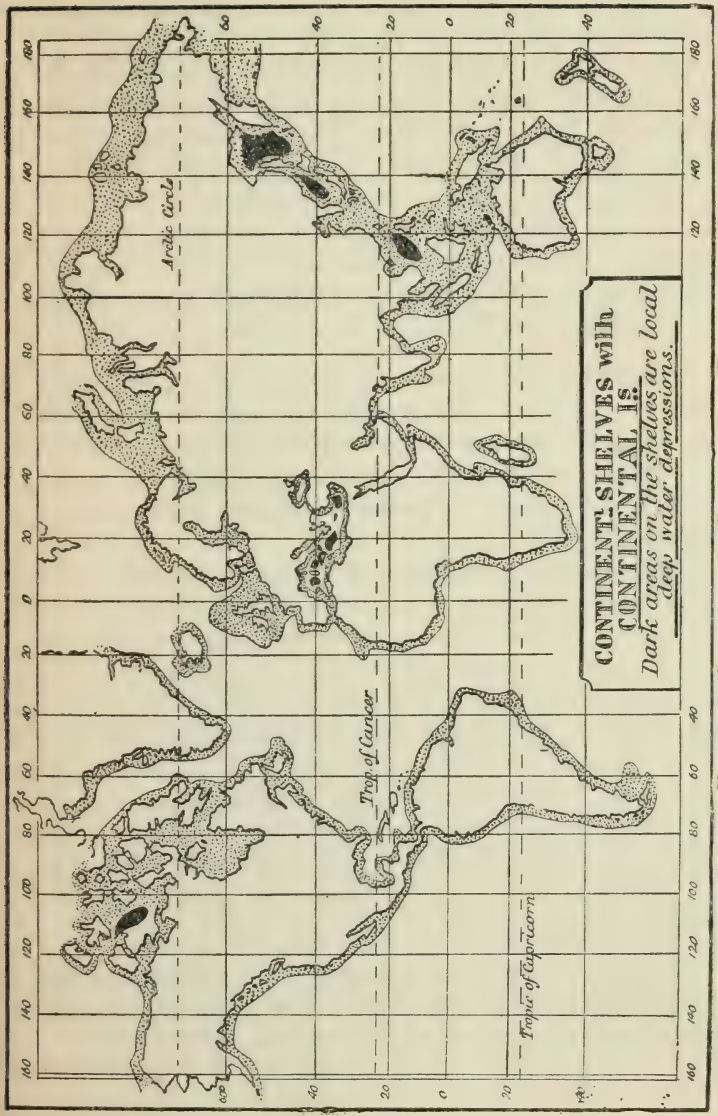

Arctic circle
Trop. of Cancer
Trop. of Capricorn
CONTINENT, SHELVES with CONTINENTAL IS.
Dark areas on the shelves are local deep water depressions.

FIG. 74.—CONTINENTAL SHELVES AND ISLANDS.

and not to the variant action of waves on soft and hard materials (marine denudation).

Fig. 74 shows the continental shelves of the world, and suggests to the student that even separated continents have *linking platforms*, in the shape of these continental shelves. A reduction of 200 fathoms in the surface level of the oceans would leave them intact, but would suffice to link North America and Asia across the Behring depressions, Asia and Australia through the Philippines and East Indies. A continuous margin of land from Cape Horn, round by Kamschatka to Tasmania, would shut in the Pacific Ocean.

Continental Archipelagos.—The majority of the world's *islands* are merely the *higher parts* of the continental shelves standing, as it were, waist deep upon the submerged platforms. Examples especially worthy of note are:—

The British Isles, Newfoundland, Ceylon, the East Indies, Japan, Tasmania.

Moreover, the *inland seas* of the continents are merely *submerged depressions* of the continental shelf, just as the islands are *emergent uplands*. Sometimes the depression is abnormal, giving very deep inland seas. For these depressions other crust forces must have been responsible. A chain of such *deep depressions* occur in the Mediteranean, dividing the European continental mass from that of Africa, and another is found within the chain of islands which extends from Japan to the Philippines. On the other hand, the White Sea, the Baltic, the British seas, Hudson Bay, and the Gulf of St. Lawrence are depressed sea-covered portions of the continental shelf.

Fisheries.—It is worthy of note in this connection that the principal *fisheries of the world* are to be found on these continental shelves or submerged platforms.

CHAPTER V.

The Oceans.

[Maps to be studied: Bathy-Orographical Map of the World; Ocean Currents; Ocean Deposits; Maps showing Co-tidal Lines.]

THE exploration of the oceans began with Columbus and Diaz, the Cabots and Da Gama, at the close of the fifteenth century. Within a hundred years the extent of the ocean surface of the world had been ascertained and fairly accurately mapped by navigators. It was found that the oceans covered nearly three-quarters of the globe, or three times as much area as the continents; and that the continents lay chiefly *north of the Equator*, whilst the southern ocean wrapped the globe around in one broad belt of water.

Systematic Investigation.—It was not until the nineteenth century, the age of machinery and the telegraph, that exploration of the ocean *depths* was undertaken, prior to the laying of electric cables between Europe and North America. Since 1853, when the U. S. brig, *The Dolphin*, made investigations of the temperature of oceanic waters, the teeming life of the seas, the form of the ocean floor, and the nature of the deposits covering it, many expeditions have been undertaken by different nations, but especially by Great Britain* and the United States. The result has been to prove that *the oceans are the real depressions* of the earth's crust, whilst the continents are the elevated portions. Mountains and basins,

* 1857, H.M.S. *Cyclops*; 1872, H.M.S. *Challenger*.

plateaux and valleys become *minor features* of elevation and depression upon the standing continents.

The major depressions, which form the beds of the oceans, have also their minor features of elevation and depression—deeps and ridges descending below and rising above the general average of the ocean floor. For the geographer the *submarine ridges* are of greater interest than the *abyssal deeps*, for it is from them that summits of submarine mountains emerge above the ocean surface as *oceanic islands*. The principal ridges and deeps are indicated on Fig. 75. The deepest parts of the ocean reach more than 4,000 fathoms (24,000 ft.); a deep sounding in the N. Pacific, just east of Japan, is 4,655 fathoms, or (27,930 ft.) nearly as deep as Mount Everest, the premier mountain, is high. The deepest sounding yet made is to the east of the Ladrones, N. Pacific, 5269 fathoms, roughly six miles. It is remarkable that the abyssal depths of the ocean lie, in practically every case, *close to the continental shelf* and not (as one might expect) in mid-ocean. Indeed the mid-ocean is more characterised by submarine ridges with groups of islands rising therefrom. Almost bisecting the Atlantic Trough, we have the *Dolphin Ridge* in the northern section linked by other ridges to the *Challenger Ridge* in the southern section. From the Dolphin ridge emerge the Azores as summits of lofty submarine volcanoes. Similarly, Ascension and Tristan d'Acunha rise from the Challenger Ridge. The deepest part of the Atlantic is found just outside the volcanic Antillean chain of West Indian Islands. The broad ocean of the Pacific has the *Sandwich Ridge*, surrounded by volcanic islands, and the *Tuscarora Deep*, just outside the chain and volcanic archipelago of the Japan seas, in its northern section. A radiating group of ridges, bearing the several groups of the South Sea Islands, occurs in the southern Pacific; an abyssal depth is reached close to the South American continent.

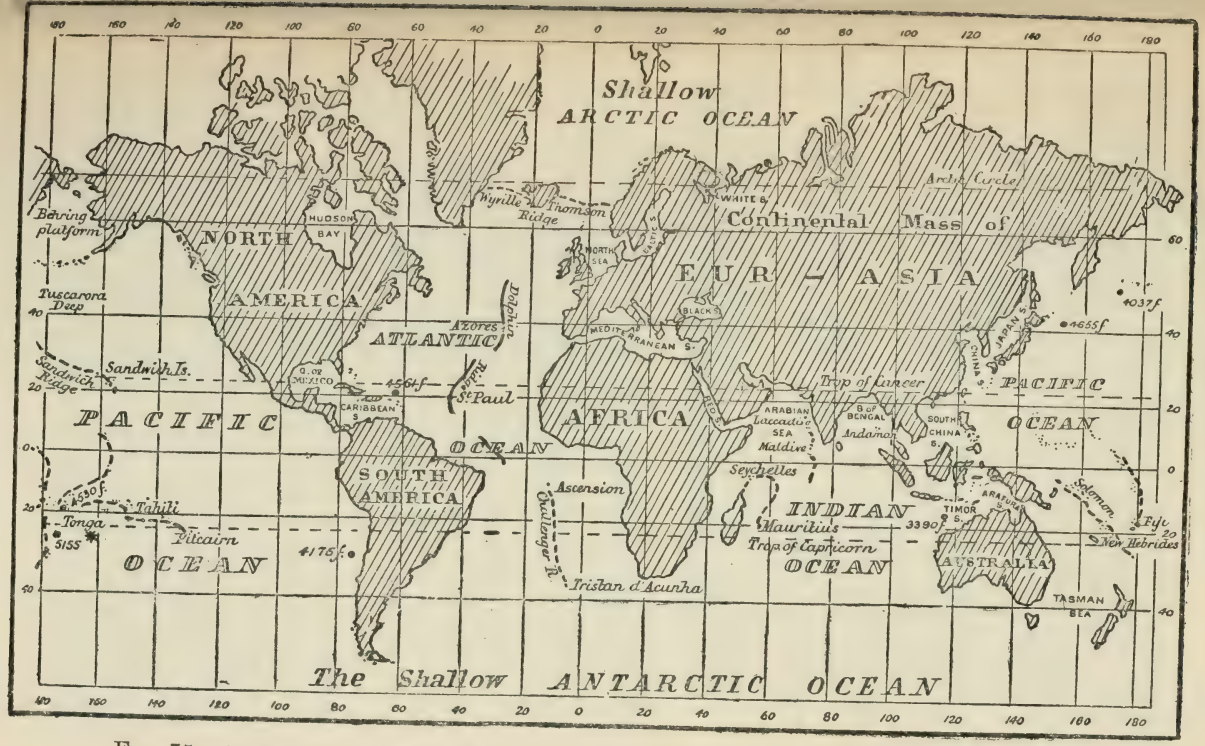


FIG. 75.—THE OCEANS, THEIR SUBMARINE RIDGES, AND THE ISLANDS EMERGING FROM THEM.
(The student should compare the map with Fig. 74, Chap. IV.)

Oceanic Islands.—The student will now distinguish between *continental islands* (emerging portions of a submerged continental shelf) and true *oceanic islands* (summits of peaks usually volcanic, rising from mid-oceanic submarine ridges). It is impossible on the page of a text-book to show a section *to scale* across either continent or ocean basin. Taking the average depth of the ocean as $2\frac{1}{2}$ to 3 miles, a diagram even for the Atlantic would dwindle to a mere line in thickness. The importance of oceanic islands will be brought out in subsequent chapters.

Coral Islands.—A distinct type of oceanic island is the *coral island.* The coral is a lowly marine organism of small

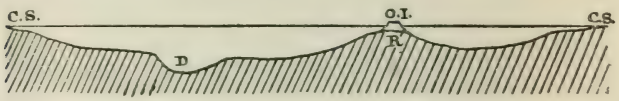


FIG. 76.—GENERALISED DIAGRAM (vertical scale grossly exaggerated) OF A SECTION ACROSS AN OCEAN BASIN.
(C.S.=continental shelf; D.=deep; R.=submarine ridge; O.I.=oceanic island.)

size, zoologically related to the much larger and more familiar sea-anemone of our pools, and in no way related to the Insecta. It lives in colonies which build up for themselves a limestone tenement—the coral rock mass—each chamber of which is occupied by an individual coral. The coral reef-builder does not thrive in dirty water, deep water, or in water whose temperature sinks much below 70° F. The organism feeds on particles borne within reach of its tentacles by *ocean drifts.* On the whole, therefore, coral islands occur ***within the Tropic Zone*** and, since ocean currents within the tropics are predominantly westward (see next section) the coral-covered oceanic islands occur in the *west* of the Atlantic (*e.g.*, Barbados, Bermudas and Bahamas), and of the Pacific (include the great Barrier Reef of Australia) and also of the

Indian Ocean (*e.g.*, among the Seychelles). In some cases the coral wraps like a *ring* round a volcanic cone (*e.g.*, in *atolls*), in others it fits upon a volcanic stump like a *thimble* (*e.g.*, Barbados); off the coast of Australia, the parts of the continental shelf, which are *free from river sediments*, are covered by coral reef-building colonies.

The polar oceans are both of them comparatively shallow, though Nansen observed 2,000 fathoms near the North Pole. Separating the northern Arctic Ocean from the Atlantic runs the broad submerged platform known as the *Wyville Thomson Ridge*, which links Iceland with Europe and Greenland, and so with the American Continent. The *Behring platform* similarly cuts the Arctic off from the Pacific. The Antarctic Polar Continent sends out long projections of submarine shelf towards the Pacific and Atlantic Basins.

Polar Regions.—The presence of a *Polar Continent* of great size around the South Pole affords a striking contrast to the *Polar Basin* of the Arctic Ocean, hemmed in by three continents. *Antarctica*, as the South Polar Continent is called, is separated from its fellow continents of the Southern Hemisphere by the broad zonal Antarctic Ocean. The continent is, of course buried under a polar *ice-cap*, through which emerge volcanic cones even in this kingdom of frost. In the same way the bare "*nunataks*" of Greenland rise through the *névé* of the ice-fields of the plateaux. It is from the fringes of these covering ice-caps that icebergs are broken off.

Oceanic Waters.—The waters of the oceans differ from those of rivers which run into them in containing a considerable percentage of *dissolved salts*, especially chlorides of sodium (NaCl, common salt) and magnesium ($MgCl_2$). Some sulphates occur, especially sulphate of lime ($CaSO_4$). The *absence of carbonates* is remarkable, since carbonate of lime ($CaCO_3$, the composition of limestone) is prevalent in many river waters. The fact is that the myriad organisms forming

the "*plankton*" * of the surface-waters of the ocean extract the lime to form their *tests* (*i.e.*, minute shells). The saltness of the ocean waters varies in different latitudes and in inland seas. Wherever *evaporation* is excessive, there the percentage of salinity will be high; a region receiving many mighty rivers will be salt below the average. Inland seas, with no outflowing river will be most salt of all, for in such cases evaporation is so great as (at least) to keep pace with river inflow. It is *in the tropics* that the surface waters of the ocean are saltest, and therefore densest (d=1·028). The proportion falls as we travel towards either pole, till in Arctic seas the relative density of sea-water is 1·024.†

i.e., the proportion of salts has fallen in the ratio 28 : 24 or 7 : 6.

The Baltic, in high latitudes, and fed by a copious supply of river-water, is almost fresh water, density falling as low as 1·004.

Proportion of saltness is therefore—

Tropics.		Arctic Ocean.		Baltic.
28	:	24	:	4
7	:	6	:	1

Of the two chlorides, common salt (NaCl) is nine times as plentiful as the chloride of magnesium ($MgCl_2$). Other salts are present in negligible quantity. Three and a half parts in 100 by weight of sea water are represented by the whole of the salts.

The importance of these salts for the geographer is their *effect on the freezing point* of oceanic waters. The freezing point falls lower and lower below 32° F. or 0° C. in proportion to the percentage of saltness. Moreover, salt-water differs from pure water in not being densest at 4° C. This peculiar anomaly of pure water does not hold in the case of solutions. Density increases as temperature falls to the special freezing point of the solution. Hence, the *densest* waters are the

* Gk., *plankton*; floating drift life.

† Surface waters are fresher than deeper and denser currents.

coldest in the case of sea water *of uniform composition*, and, in accordance with the general laws of the physics of liquids, will be found *along the ocean floor*. The average temperature of the waters of the abyss is found to be about 30° F. (*i.e.*, 2° below F.P. of pure water); in some of the "deeps" a still lower temperature has been measured. This low temperature is practically true for *all latitudes*, whereas *surface waters* differ very markedly with latitude. Thus, the average temperature of surface waters in the Tropics is about 80° F. whereas in the neighbourhood of the Arctic circles it is as

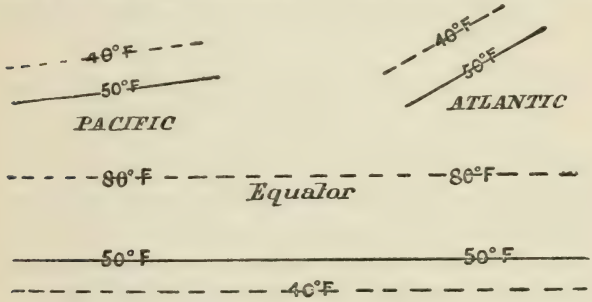


FIG. 77.—OCEANIC ISOTHERMS COMPARED.

low as 40° F., and, of course, within the polar seas descends to freezing point (salt water).

	Equator.....	Lat. 60° N.
Surface	80° F.....	40° F.
Abyss	30° F.....	30° F.
	50° F. fall of t°.	10° F. fall of t°.

The fall of temperature of surface waters is almost *regular*, according to latitude, in the Southern Hemisphere, where *no large continental masses* modify the circulation of oceanic surface waters.

In the Northern Hemisphere the *modifying effect of the*

continental masses is noticeable, and more especially in the narrow Atlantic.

In Fig. 77, the lines are *isotherms for oceanic surface waters.** The 50° F. (north) shows some irregularity in the *broad* Pacific and much more in the *narrow* Atlantic. We shall notice in the next section the distribution of warm Equatorial waters towards the Polar seas, and the student will see that the obliquity of the lines in the figure is due to the exigencies of such circulation of ocean waters. The Indian Ocean, *north* of the Equator, is *hottest* of all, precisely because its waters cannot circulate outside the northern Tropic Belt.

Line 40° F., similarly affected, practically marks the *limit of icebergs*, which, on reaching this water isotherm, melt away.

Oceanic Deposits.—We noticed in Chapter IV. that the shallow seas of the *continental shelf* were the localities of the principal *fisheries*. Light can penetrate to the submerged platform. Out in the open ocean fishes are scarce, but the surface layers abound in *minute forms of marine life* (plankton), many of which give rise to the *phosphorescent light* so characteristic of the wake of a ship during the night. The decay of these microscopic organisms results in a continual rain of tests (microscopic shells) to the abyssal floor. The tests are predominantly of two types :—

(*a*) Calcareous (limy), of which *Globigerina* is the best known.

(*b*) Siliceous (flinty), of which *Radiolarians* are the commonest forms.

The limy shells are more numerous and more fragile than the siliceous. In their fall towards the depths the *limy shells* are liable to be dissolved in water under great pressure. Even the *flinty tests* may be dissolved before the abyssal "deep" is reached. This explains why :—

* Isotherms usually refer to *air*-temperatures at sea-level.

(*a*) On the *shallower* parts of the ocean floor globigerina and radiolaria, and dust fragments, all occur together [Globigerina Ooze].

(*b*) On the *deeper* parts globigerina disappear, leaving only radiolaria and dust fragments [Radiolarian Ooze].

whilst

(*c*) In the *abyssal depths*, only Red Ochrey Clay is found [Abyssal Red Clay].

The Oozes (*i.e.*, soft muds) are named after the *predominating* constituent.

Deposits of sand, gravel and fine silt are spread out in *broad fans* (submerged deltas) upon the continental shelf by rivers. A river like the Amazon spreads its fine silt as far as 300 miles beyond its mouth.

The *Globigerina Ooze* shows striking resemblances to our *English Chalk*, and suggests the mode of origin of chalk.

Radiolarian Earths are known, but are much less prevalent than chalk.

Red Clay is derived from the clouds of *volcanic* pumiceous dust scattered over the surface of the oceans. The abysses of the ocean are, in nearly every case, in close proximity to a seismic line with its chain of volcanoes. (*See* Fig. 75.)

The floor of the *colder* oceans is overlain with diatomaceous ooze made up of *diatoms*, frustules of minute marine *algae* (plant-forms).

Movements of the Ocean.—The one characteristic of the ocean, which more than any other strikes an observer, is its restlessness. The movements, which are of most importance to the geographer and in the interests of commerce, are capable of scientific explanation. These movements are independent of each other, being due to entirely different causes. They are—

(*a*) Ocean Currents. (*b*) Tides.

(*a*) **Ocean Currents.**—The currents have been very carefully mapped in the interests of navigators, and most of the more important have received names. The student should consult a *map of ocean currents* and memorise the names of the principal drifts. If we observe the tendency of flow of

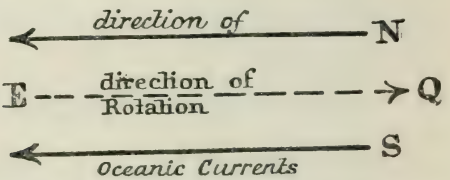


FIG. 78.—EQUATORIAL OCEANIC CURRENTS.

surface waters in the tropics we notice, in the first place, that the flow is *westward* (*i.e.*, opposite in direction to the earth's rotation). This feature is more marked in the broad Pacific than in the narrow irregularly-enclosed Atlantic. This westerly tendency of the drift of oceanic waters cannot be attributed to differences of temperature, for it is evident that such would tend to give a northward or southward drift. The only explanation would seem to be that the solid Earth, rotating from west to east, starts a *tendency of flow towards the western wall* of the oceanic basin. We have hinted at *a northward tendency* due to differences of temperature of oceanic surface water in different latitudes. This introduces another factor in the determination of ocean currents. The *influence of the walls of the ocean basin* in deflecting (and even dividing) a current striking them is a third factor, whilst last, but not (according to some authorities) least, the *effect of steady winds* blowing constantly in approximately the same direction (*e.g.*, Trade Winds; see next chapter), is a fourth factor in developing ocean currents in surface waters. Be it noted, we are not here specially considering deep water currents. The westward tendency considered due to rotation,

coupled with the northward tendency due to difference of temperature, would issue of themselves in a *north-westward* rather than a true westward sweep.

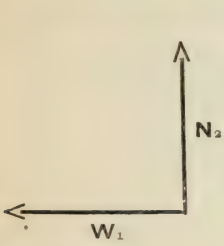


FIG. 79.—CASE OF N. HEMISPHERE.

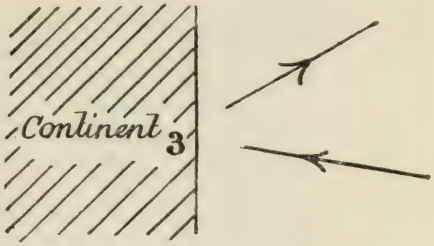


FIG. 80.—DEFLECTION OF CURRENT (N.H.).

The continental mass, if presented broadside to the stream, would tend to deflect the current roughly in accordance with the *laws of reflection*, thus turning the current so as to make it strike in a N.-E. direction. (Figs. 79 and 80.)

South of the Equator similar causes would set up a S.-W.

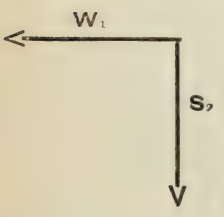


FIG. 81.—CASE OF S. HEMISPHERE.

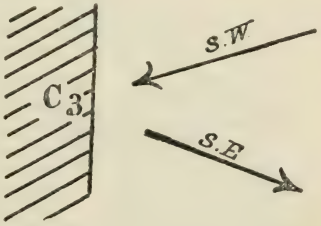


FIG. 82.—DEFLECTION OF CURRENT (S.H.).

current deflected by a continental mass toward the S.-E. (Figs. 81 and 82.)

An *elbow* of continent would tend to split the drift into two sections. A good example of this is seen in the currents of the South Atlantic striking the coasts of *Brazil*. (Fig. 82 *a*.)

The influence of *constant winds* cannot be too strongly insisted on; and it is remarkable that these winds practically *coincide with the main directions* of the ocean-drifts. Whilst

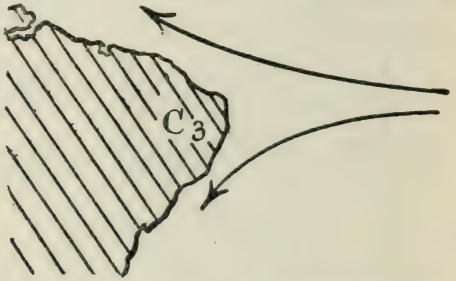


FIG. 82 *a*.—CASE OF THE BRAZILIAN COAST.

ocean-drifts cannot set up constant winds, it is certain that constant winds can, and do, set up surface ocean currents.

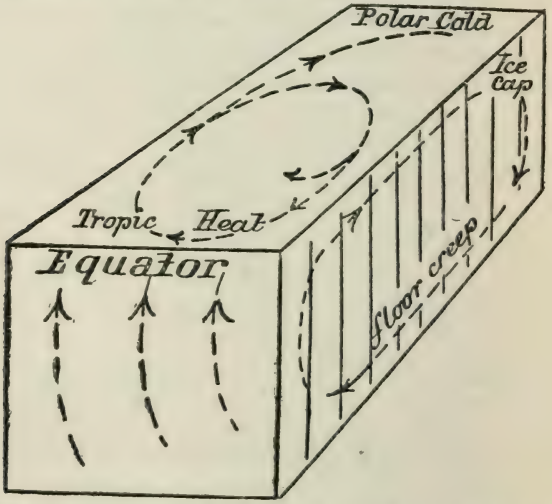


FIG. 83.—AN ATTEMPT TO ISOLATE THE SURFACE AND BODY TENDENCIES OF OCEANIC CIRCULATION. (The resultant is too complex for diagrammatic representation).

The student should consider Fig. 83, which attempts to illustrate diagrammatically the *tendencies* of the general circulation of the northern half of an ocean-trough (*cf.* the Atlantic). The reader is warned that actual circulation can scarcely be represented by any diagram. Fig. 84 indicates

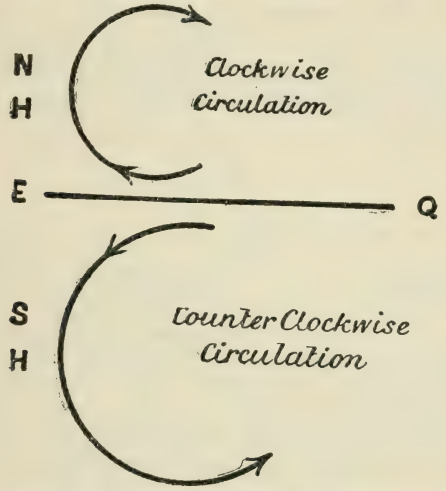


FIG. 84.— GENERAL DIAGRAM ILLUSTRATING OCEANIC SURFACE-CIRCULATION NORTH AND SOUTH OF THE EQUATOR.

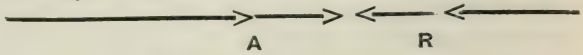
the *general law* of surface oceanic circulation north and south of the Equator (line of quickest rotation).

The deviations from the general curve are practically *explainable by the shape of the ocean-basin* or trough. The cycle of movement is completed in accordance with the requirements of relative equilibrium.

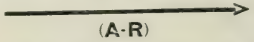
We noticed in the first section of this chapter the engirdling belt of the *Antarctic Ocean*, of which the Northern Hemisphere can afford no equivalent, owing to land-masses.

Fig. 85 will make clear why the general circulation of oceanic waters in the Antarctic is in the *same* direction as the *rotation* of the Earth; not therefore due to rotation, but

sufficiently strong to overcome rotation; thus if A represents



the aggregate tendency due to the previous history of the water's movement and R=tendency set up by Earth's rotation,



the resultant is (A—R) in the direction of A. The importance of currents to the navigator, and more especially in the old

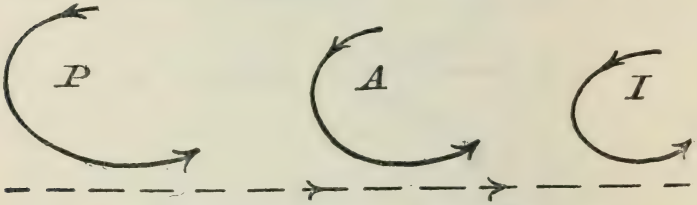


FIG. 85.— ANTARCTIC DRIFT. (See attached figure.)
P.=Pacific Ocean; A.=Atlantic Ocean; I.=Indian Ocean.

days of sailing ships, will be obvious. The even greater importance of currents as *distributors of heat*, and therefore as *factors in climate*, will be fully considered later.

(*b*) **The Tides.**—The most familiar phenomenon of regular oceanic movement is that of the Tides. Twice every day our bays and estuaries fill with the incoming tide, and empty

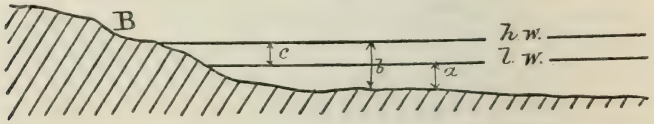


FIG. 86.—RANGE OF THE TIDE.

with the receding ebb. We speak of the tidal wave, and quite correctly so, but the importance of the tides to commerce is due to the deep waters in our harbours and docks consequent on high-tide, making them able to carry ocean-going vessels.

and affording access for such vessels to docks and ports considerably inland on estuaries.

Let B (Fig. 86) be one of the banks of an estuary, *lw* the level of the water in the estuary at low tide, *hw* the level at high

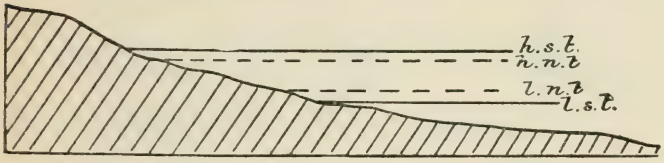


Fig. 87.—Spring and Neap Tides.

tide. Then the depth, *a* feet, at low tide might carry small vessels, whereas the depth, *b* feet, at high tide would be able to support (say) the largest ocean-going vessel. These conditions largely determine whether the site B is suitable for a port or not. The difference between high-water mark and low-water mark, *c* feet, is generally in estuaries as much as from ten to twelve feet, and is often more. The *regularity* of tides, so regular that the moment of high

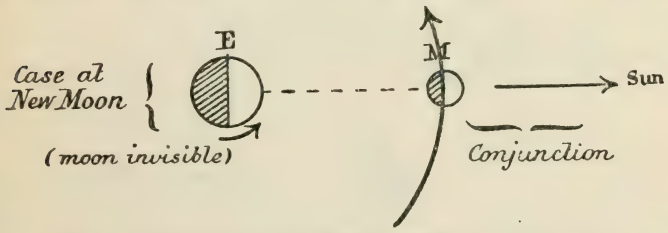


Fig. 88.—Case at New Moon (Moon Invisible).

tide can be *predicted* in advance, is of great advantage to commerce.

We have now to consider the theory which best explains the cause of the tides and their regular recurrence. Newton hinted at the solution; Laplace worked at it; Professor G. H. Darwin has elaborated the theory. The facts, with regard

to tides, seem to point to the influence of the Moon upon the water-envelope of our globe. They are as follows:—

(*a*) Once a fortnight we get very high flood tides, accompanied by very low ebb tides. (*Spring Tides.*)

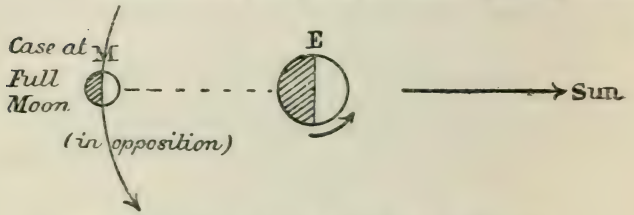


FIG. 89.—CASE AT FULL MOON (IN OPPOSITION).

(*b*) Alternating with these, and midway between, we get once a fortnight average tides, neither very high nor very low. (*Neap Tides.*)

(*c*) Tides do not recur once in exactly twelve hours, but at an interval of about twelve hours twenty-five minutes on an average.

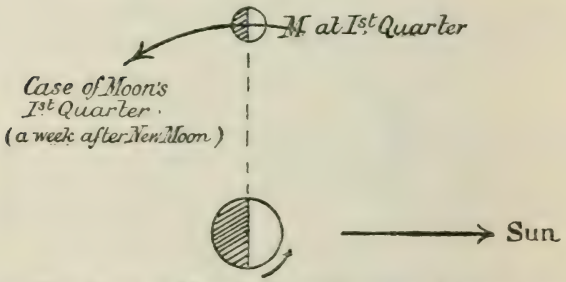


FIG. 90.—CASE OF MOON'S FIRST QUARTER (A WEEK AFTER NEW MOON).

The theory connects these facts with known facts with regard to the Moon:—

(*a*) At New Moon and Full Moon (a fortnight apart in time) the Moon is in a straight line with the Earth and the Sun—at *New Moon*, in what the astronomer calls *Conjunction* (with the Sun), and at *Full Moon* in *Opposition* (Figs. 88 and 89).

(*b*) Midway between New Moon and Full Moon, and between Full Moon and the next New Moon, the Moon is said to be in *Quadrature*. The relative positions of Earth, Sun and Moon are represented in Figs. 90 and 91.

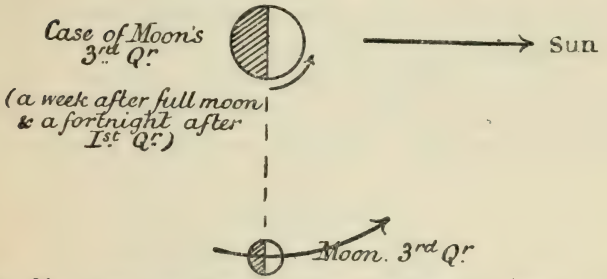


FIG. 91.—CASE OF MOON'S THIRD QUARTER (A WEEK AFTER FULL MOON AND A FORTNIGHT AFTER FIRST QUARTER.)

For purposes of argument, let us consider the simplest case, namely, that of an Earth entirely wrapped in an envelope of water. In the case illustrating New Moon (Fig. 88),

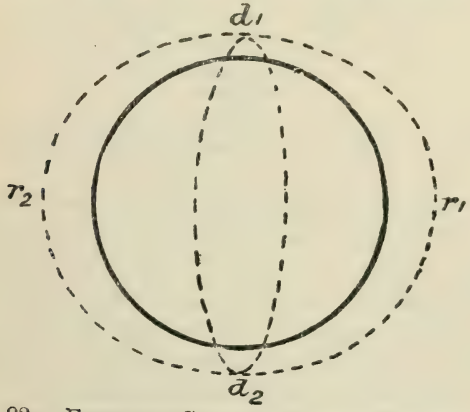


FIG. 92.—EFFECT OF SUN AND MOON IN CONJUNCTION.

gravitational forces of Sun and Moon are acting *together* on the solid Earth and its liquid envelope. The Earth will be

attracted as a whole, and not deformed by gravitational forces. The liquid envelope will tend to be drawn more towards r_1, and away from $d_1 d_2$ (Fig. 92). Gravitation will tend to draw the solid globe away from r_2. The result will be a heaping of waters at r_1 and at r_2 with consequent depression in the belt $d_1 d_2$. The heaping is so slight that no diagram can represent it accurately, and the student must be warned against the very great *exaggeration* of text-book diagrams which attempt to show it. If the warning is heeded, the diagrams have their value and serve their purpose. The

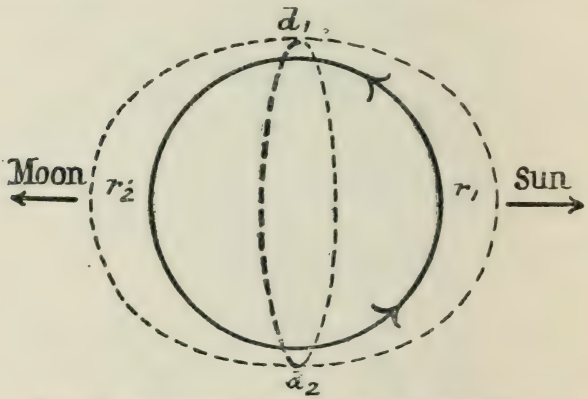


FIG. 93.—EFFECT OF SUN AND MOON IN OPPOSITION.

height of the *tidal wave* in mid-ocean is not more than 2 ft. infinitesimal compared with the depth of the earth's centre (say $4{,}000 \times 5{,}280$ ft.), or even of the ocean itself (say 15,000 ft.). The heaping of waters at the geometrically polar points r_1 and r_2 with accompanying depression in the belt $d_1 d_2$ (Fig. 93) will be even more obvious, though not more actually, in the case of the Moon in *opposition* (Full Moon).

In these cases, the heaping up of the water at r_1 and r_2 should be a maximum. Now let the Earth rotate. It is evident that the water of each part of the envelope will tend

to be raised as it moves towards r_1 or r_2 from d_2 or d_1, and to be depressed as it moves towards d_1 and d_2 from r_1 and r_2; r_1 and r_2 correspond to the moment of *high tide*, d_1 and d_2 correspond to the moment of *low tide*. And r_1 and r_2 are a maximum, whilst d_1 and d_2 are a minimum. This would explain a *very high* tide followed in about 6 hrs. ($\frac{1}{4}$ rotation) by a *very low ebb* tide, *i.e.*, Spring Tide; and it is a fact that *Spring Tides* are connected with Full and New Moons as regards time, usually following close upon the heels of New

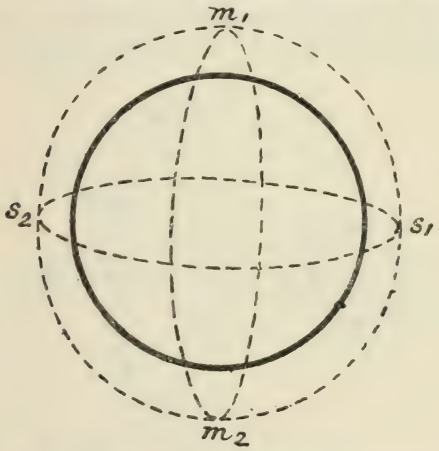


FIG. 94.— CASE OF MOON IN QUADRATURE.

and Full Moon, but if lagging, then for reasons quite easily explained.

The student will at once see that in the cases of quadrature, we have a contest of gravitational forces, the Moon tending to heap the waters at m_1 and m_2, whilst the Sun's gravitation tends to raise them at s_1 and s_2. The issue depends on which of the two exerts the stronger gravitational force. The Sun's mass is immensely greater than that of the Moon, but his distance from the Earth is about 360 times that of the Moon. Astronomers calculate that the Moon's tide-raising

power is $2\frac{1}{4}$ times that of the Sun. Therefore m_1 and m_2 will be places of heaping of the water, whilst $s_2 s_1$ are points on the belt of depression. Since the Sun's gravitation *tends to counteract* the Moon's attractive force, the heaping and depression will each be less marked, which exactly coincides with what we experience at *Neap Tides*. Spring and Neap Tides do not occur exactly at full and new moon or first and third quarters, as the theory would suggest. They lag behind somewhat for a time, which varies from a few hours to three days.

Tides do not succeed each other every six hours ($\frac{1}{4}$ rotation). The explanation is to be found in the movement of the

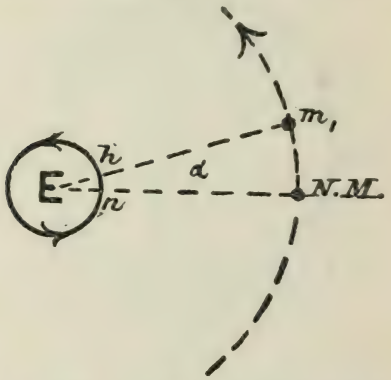


FIG. 95.—CASE OF TIDES ABOUT A DAY APART.

Moon in its orbit relative to Earth and Sun. Let NM (Fig. 95) represent the position of the New Moon at Spring Tide, and m_1 the following day's position of the Moon at high tide. Then the Earth must make *one complete rotation*+*nh* (*angle* α) before high tide is experienced. This will require

24 hrs.+x mins. (for $\alpha°$).

$\alpha°$ will be about $\frac{1}{30}$ of $360° = 12°$.

[We are neglecting the counteracting effect of the Sun.]

x is found to be about 50 to 60 mins.

Therefore 24 hrs.+(say) 55 mins. is the average time-interval between one high tide and the *second* following high tide. This works out as 12 hrs.+about 27 to 30 mins. for the interval between *successive* high tides.

The foregoing account will serve to indicate the general principles underlying the problems of tides, and at the same time suggest the *mathematical complexity* of the problem when all the factors are introduced.*

Since the rotation of the Earth is from West to East, the heaping up of the water will pass *from East to West* as each place comes under the Moon.

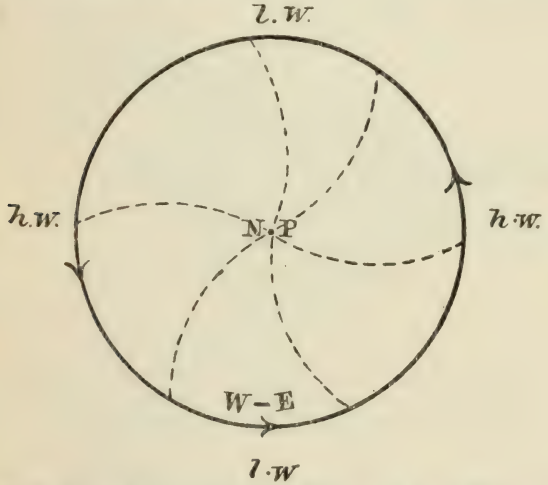


FIG. 96.—ALTERNATION OF HIGH AND LOW WATER.

Only in the encircling belt of the *Antarctic Ocean* can this be noted. The position of the tidal wave moves steadily westward, its crest extending along a meridian of longitude. But in the *land-locked oceans*, the form of the basin greatly modifies the rate of advance of the wave. *Friction* retards the progress of the wave on the land margins. In the open ocean the wave

* We have neglected the Earth's movement in its orbit during the 24 hrs. interval.

advances rapidly. *Archipelagos* break up the tidal wave, often with great advantage to the harbours of the Archipelago.

Thus the British Archipelago breaks the tidal wave into tidal-wavelets (so to speak), one advancing round the North of Scotland, another proceeding up the Irish Sea, whilst a third section enters the English Channel. A map of British *co-tidal lines* shows two tidal waves approaching the mouth of the **Thames** at the *same hour*. This tends to give an *exceptionally deep* estuary at high tide. If two tidal wavelets

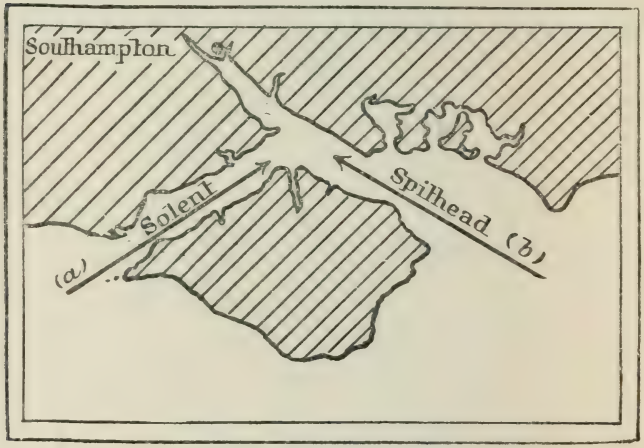


FIG. 97.—DOUBLE TIDES AT SOUTHAMPTON.

enter the same sea at *intervals of six hours*, it is evident that the practical result will be to keep the basin constantly in a state of *average high tide*.

Such a state of affairs is fairly well exemplified in **Southampton Water**, where tide elements, (*a*) from the Solent, and (*b*) from Spithead, enter the estuary at different times, and help to make Southampton an important packet station.

Funnel-shaped estuaries greatly modify the motion of the tidal-wave. Crowding into a continuously narrowing channel,

the wave is heaped up as it advances, and presents an *advancing wall* of water as it moves up the estuary. The ultimate effect is to give *exceptional range* between high-water and low-water marks. The **Bristol Channel** affords the best British example of this phenomenon, in the "*Bore*" of the Severn. The most remarkable "bore" is that of the **Bay of Fundy,** in North America.

A "bore" becomes a "*Race*"-when forced through a strait instead of into an estuary. The Pentland "race" in the firth separating the Orkneys from the mainland is well known. The Race of Alderney was responsible for the wreck of *The White Ship*.

CHAPTER VI.

The Atmosphere and Climate.

[Maps to be studied: Isothermal and Isobaric Maps of the World; Maps showing Winds, Distribution of Rainfall, and Ocean Drifts.]

In Chapter V. we considered the circulation of oceanic waters; we now proceed to consider the *gaseous envelope* which we call the **atmosphere**—its composition and movements. Being more fluid than water, and not confined within basins, its movements are of necessity more delicate and complex.

Constitution of the Atmosphere.—The gases which predominate in the Atmosphere are Oxygen and Nitrogen. Oxygen forms 20·9 % by volume of the atmosphere, and Nitrogen 78·16 %. Since Oxygen is slightly heavier than Nitrogen, in the ratio of 16 to 14, the proportions by weight are:—

$$(20{\cdot}9 \times 16) : (78{\cdot}16 \times 14) \text{ or roughly } 14 : 50.$$

Oxygen is the life-supporting gas of the atmosphere, active in its properties; *Nitrogen* acts as a diluent, inactive or inert in its characteristics. The remaining 0·94 % (by volume) of the Atmosphere is made up of *Carbonic Acid Gas* (CO_2, carbon dioxide) together with very small quantities of gases even more inert than Nitrogen, and only in recent years distinguished from Nitrogen by very elaborate methods of analysis as having *different atomic weights.*

Carbon dioxide is given off by animals and plants (*during the night*) in breathing. It is injurious to health. *During the day*, plants retain the carbon and eliminate the oxygen, and so help to keep down the percentage of this gas in the air. Carbon dioxide is more soluble in water than oxygen, and much more so than Nitrogen. Hence it is that rain-water contains a perceptible percentage of carbon dioxide (CO_2), sufficient to make it a slightly acid solution, and as a result, a powerful agent of disintegration as it percolates through porous rocks.

The gases of the atmosphere occur *mixed, not chemically combined*, and thus form what the chemist calls a "mechanical mixture." Hence the proportions of the gases

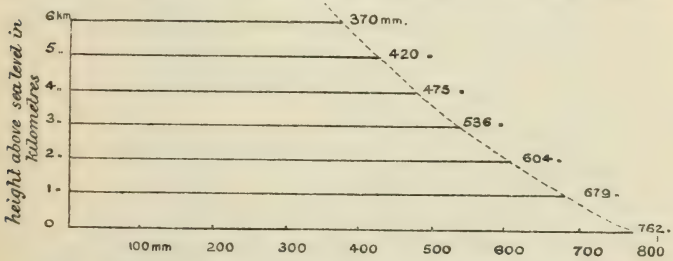


FIG. 98.—DECREASE OF PRESSURE WITH ALTITUDE.
(*Height of the barometer in millimetres.*)

given above are not necessarily constant from place to place, though experience proves them to be remarkably so under the circumstances.

The Height of the Atmosphere.—The thickness of the atmospheric envelope is a matter of conjecture. Glaisher proved, by making a daring ascent in his balloon, that at 7 miles from the surface of the Earth, the air is so attenuated that all the rest of the envelope outside the 7 miles limiting shell gave a barometric pressure of only about 7 ins. It is possible to construct a *curve of barometric pressures* and *altitudes* and so make a shrewd guess at the extreme limit of

the envelope as defined by zero pressure of the barometer. Since Glaisher found it impossible to exceed 8 miles, it is clear that observations are restricted. The general agreement of physicists under present observations is to consider the thickness of the air-envelope as somewhere between 50 miles and 200 miles—a fairly wide statement.

Of course, being *fluid*, the Atmosphere is subject to the laws of gaseous fluids. And one of the most important facts about the atmosphere is that its density decreases as we ascend from the Earth towards the limit of the envelope. A litre of air on Lake Geneva is heavier than a litre of air at the top of Mount Blanc. Air, unlike water, is *very compressible*, and so the lower layers existing under the pressure of the layers above them are more compressed than the upper layers. The fall of the barometer as we ascend a mountain or rise in a balloon is due, even when we neglect aqueous vapour in the air, to two causes:

1. The decrease in *thickness* of the envelope pressing upon the barometer.
2. The decrease in *density* of the successive layers.*

We have hinted at the presence of a modifying influence upon barometric pressure. viz., *aqueous vapour*. Whilst, apart from this influence, the barometric pressure would be practically constant at a given place, with it the pressure varies from hour to hour and day to day. The many changes of the barometric reading are only so many signs of the continual change in weather conditions at a given place from *rain* to *fair* or *change* or *dry*.

An extremely high reading of the barometer accompanies dry and settled conditions of weather. A very "low barometer" indicates the presence of much aqueous vapour in the air. Between these two extremes it is usual to strike an average and define a normal state of the barometer. *Normal*

* Apart from the mechanical laws of fluids, it is worth noticing that decrease of temperature with altitude (·5° for every 100 metres) would slightly counteract this.

pressure is defined as 30 ins., or 760 mm. on the barometer when the temperature of the air is 0°C If the mercury column of the barometer stands higher, the meteorologist speaks of a "high barometer"; if below, a "low barometer." The *presence of aqueous vapour* is the determining factor. Aqueous vapour is lighter than air, having a density only five-eighths of that of air. If, therefore, a certain quantity of the air over a given place is displaced by aqueous *vapour*, a fall of pressure ensues, and the barometer reading is low. If, on the other hand, aqueous vapour is extracted from the air over a given place (as, for instance, by a condensation and fall of rain), then air replacing aqueous vapour effects a rise in the barometer column.

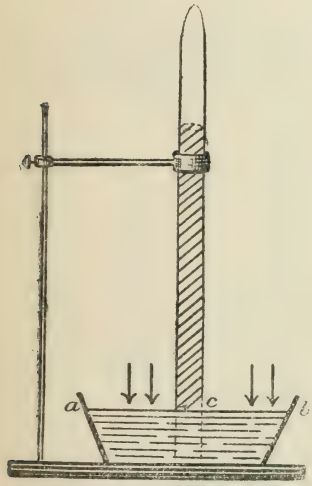


FIG. 99.—PRINCIPLE OF THE MERCURY BAROMETER.

The student should familiarise himself with the principles of construction of *Fortin's Mercury Barometer* and the *Aneroid Barometer*.

Fortin's Barometer is an improvement on the familiar mercury column standing over a dish of mercury, on the surface of which the atmosphere is pressing, in that it is made capable of more *accurate readings*. It is plain that, if *cd* (the column supported) varies from hour to hour, the level *ab* cannot be constant; a fall in *cd* means a rise in *ab*, and *vice-versâ*. Hence it is impossible to graduate the tube from a *Zero*, unless (say) the end of the tube be so chosen; then it would be necessary to take two readings, *c* and *d*, and subtract.

Fortin avoids this by making the dish with a chamois-leather base, capable of being raised and lowered by a screw. In this way the level of *ab* can always be adjusted to a Zero mark on the tube. An ivory pin, seen through the glass sides of the dish, just touches the mercury when the Zero mark is adjusted. The pin and its reflection in the surface of the mercury just touch. (Fig. 100 *b*.) When this adjustment is made, the upper end (*d*) of the column is accurately read by means of a *vernier*.

The Aneroid Barometer consists of a closed metal box, exhausted of air, with a thin flexible lid very sensitive to

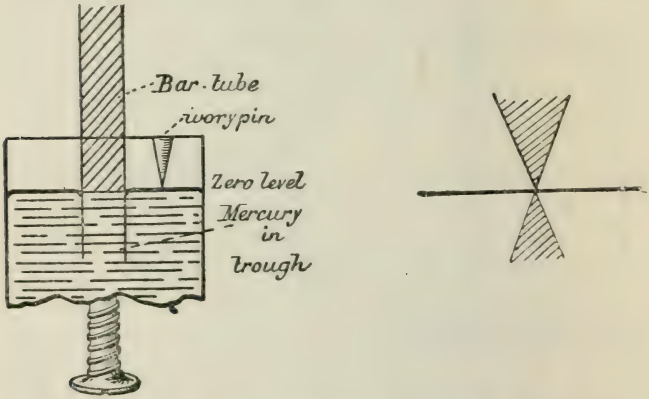


FIG. 100 (*a*) AND (*b*).—DETAILS OF FORTIN'S BAROMETER.

variations of pressure. By means of levers the variations may be registered on a barograph. So long as the flexible lid retains its elasticity the instrument gives fairly good results But when the *temper* has gone out of the metal, the indications are of little value. (The instrument is chiefly used by explorers, because of its portability.)

Normal pressure, we have said, is taken as equal to that of a column of *30 ins.* or *760 mm.* of mercury

Evidently, then, to find the pressure of the atmosphere per square inch at the Earth's surface (at sea-level) we only require to ascertain the weight of a column of mercury thirty inches high, standing on a base of one square inch. Such a column contains thirty cubic inches of mercury. Given the density of mercury (13·59), and the weight of one cubic inch of water, the result works out at $14\frac{3}{4}$ lbs. per square inch.

This gives a pressure of—

$(14\frac{3}{4}\times144)$ lbs. per sq. ft.

$(14\frac{3}{4}\times144\times9)$ lbs. per sq. yd.

or, $\dfrac{14\frac{3}{4}\times144\times9\times(1760)^2}{2240}=26{,}434{,}697$ *tons* per *sq. mile.*

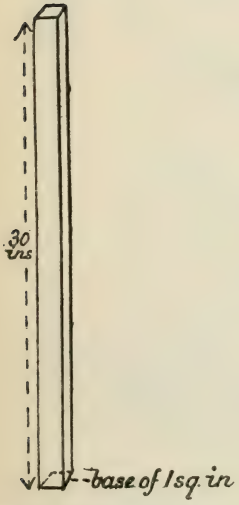


FIG. 101.—PRESSURE ON ONE SQUARE INCH.

A change of one inch in the barometer, such as may happen in changeable weather, involves a change of pressure of no less than $(\frac{1}{30}\times26{,}434{,}697)=881{,}156$ tons per square mile.

It is fascinating to consider how such changes may be connected with *earthquake disturbances* and *volcanic phenomena*. The problem becomes practical to the miner—for a *change* of *pressure in a coal mine* adds the further danger of the increased exudation of fire-damp from the sides of the pit, and, consequently, increased risk of explosions.

Isobars.—The barometric pressure changes continually at the same place and varies from place to place. This results in a continuous movement in the fluid gaseous envelope, such movement ways *tending* to set up equilibrium in the air. The move- ts are very variable and complex, but nevertheless

reducible to simple laws, the most important of which is:—"Air tends to move from a region of *higher* pressure to one of *lower* pressure."

If two places are under the same conditions of atmospheric pressure, no air-movement can take place from one to the other. A line joining all places having the same barometric pressure at a given time is called an *isobar*.* Given a chart showing isobars (really a *weather-chart*), we can deduce the movements of the air.

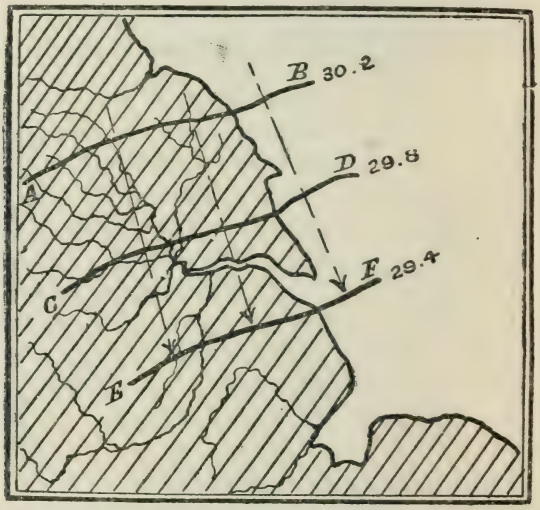


FIG. 102.—PARALLEL ISOBARS.

Let AB and CD be the isobars over Yorkshire on a given date; it is clear that the air will tend to move in the direction indicated by the dotted arrows, *i.e.*, in the direction of what is called the Barometric Gradient (see Fig. 102A); we may safely assume that a N.N.W. wind is blowing over the country. The problem becomes more complex when, as often occurs in the British Isles, the isobars turn out to be *concentric*

* Gr. *isos*=equal: *baros*=weight.

figures rather than parallel lines. The student will be familiar with charts similar to Fig. 103 given in the daily papers. Following out the reasoning on Fig. 102, the *tendency* of air-movement will be along the directions indicated on the map by the dotted arrows, *i.e.*, *towards the centre* of the **low pressure area.** It is evident that an accumulation of air at this point is impossible. In actual experience a *cyclonic** movement of the air is established. This may be explained in the following way. The student of mechanics will recall

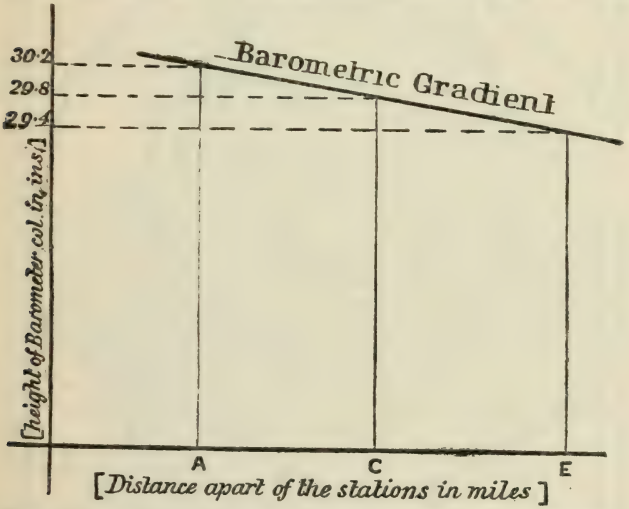


FIG. 102A.—A VERY SIMPLE ILLUSTRATION OF BAROMETRIC GRADIENT.

that in all cases of *circular motion* there is a constant force towards the centre, and will see that in a low pressure area, where the tendency of air-movement from all points of the compass is towards the centre, we have an *illustration of the general law.* It remains to explain which way the wind moves round the circle, *i.e.*, whether, when

* Gk. *kuklos*=circle.

indicated on a chart, it is *clockwise* or *counter-clockwise* in direction. Some other disturbing influence will determine this.

Let *ab* and *cd* (Fig. 104) represent two of the arrows, indicating tendency of air movement on Fig. 103.

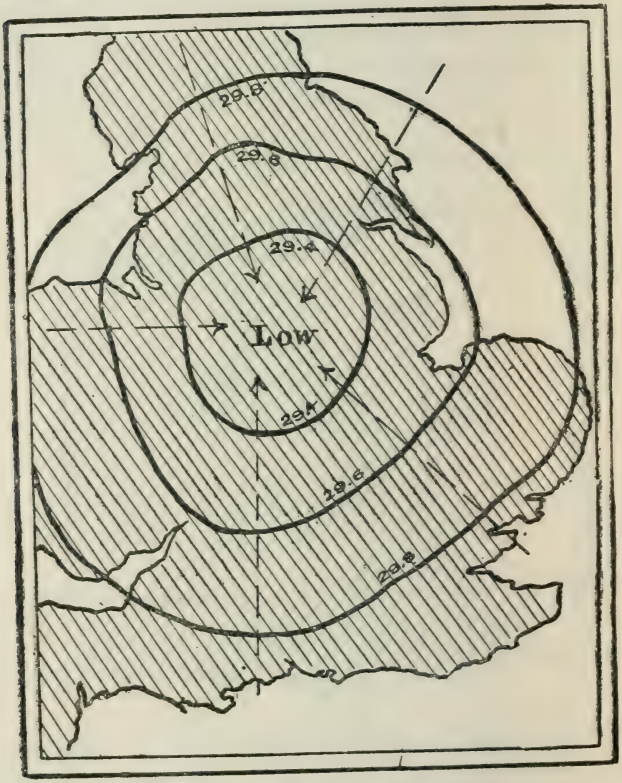


FIG. 103.— LOW PRESSURE CONDITIONS.
(*Arrows indicate direction of "Gradient."*)

In England *ab* represents movement *toward the Equator*; this is from a *slow* rotating region to a *faster* rotating region.

The tendency will be for the wind to be deflected westward,

in accordance with the mechanics of relative motion, as it moves towards the centre.

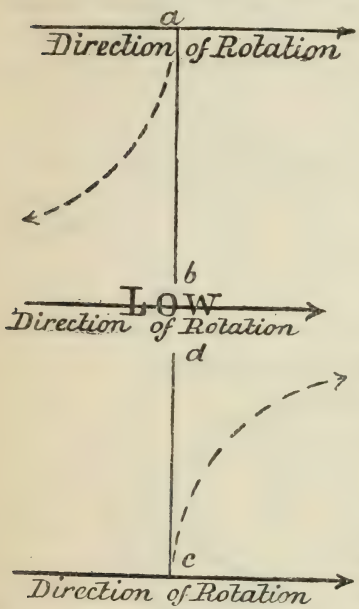


FIG. 104.—DEFLECTION DUE TO ROTATION (CYCLONE).

Vice-versâ — *cd* represents movement from a *fast* rotating region to a *slower*. The tendency will be for the wind to be deflected eastward.

In this way, we may consider the air movement in the northern half of the *Low Pressure Area* to tend *westward*, whilst that of the southern half would tend *eastward*.

A *cyclonic motion* is set up—in England, and, indeed, anywhere in the **Northern Hemisphere**—**counter clockwise** in direction.

The student should draw the diagrams for the Southern Hemisphere, and prove to himself that, across "the line," the air-movement in a low pressure area will appear clockwise when indicated on a weather chart.

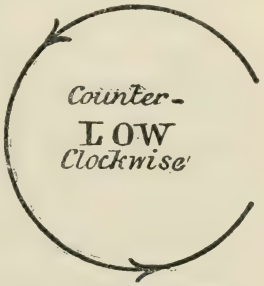


FIG. 105*a*.— COUNTER-CLOCKWISE MOVEMENT.

Weather charts usually give arrows showing wind-direction and wind-force in addition to the isobars. Thus, in Fig. 105*b*, the eastern district is at the moment experiencing a wind from the S.S.E., whereas the southern district is experiencing a W.S.W. wind

and the northern region a N.E. gale. It is natural to expect that the *character of the weather* (warm, cold, dry or wet) will depend on the *direction from which the wind comes*. Moreover, the tendency for the air to concentrate on C, combined with the cyclonic movement set up and the excess of aqueous vapour in the core of the *low pressure area*, issues, as one would again expect, in *stormy weather near the centre*. Such a condition of the atmosphere is called *a cyclone*. **Cyclones** are not stationary, but travel over the Earth, combining with their *cyclic* movement a *translatory* one.

Great Britain experiences many cyclones in the course of a year. These move over our islands from the Atlantic and

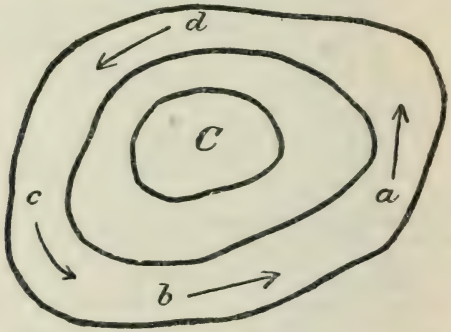


FIG. 105*b*.—CASE OF A SIMPLE CYCLONE (N.H.).

pass forward to the Continent. The track of the cyclone varies, though certain *tracks* are *pretty well defined*, and can to some extent be anticipated; hence the prophecies of the weather-clerk. Fig. 106*b* indicates the prevalent tracks of cyclones over our islands from the Atlantic. A rain storm resulting from condensation of the aqueous vapour in the low pressure area leads to a *rise* in the barometer and so to the annihilation of the cyclone.

An interesting contrast in weather conditions is that indicated by the term **Anticyclone.** In an anticyclone the centre is a high pressure area. Aqueous vapour is scarce, the

tendency of movement is outwards. and therefore the anti cyclone dissipates itself gradually in fine weather.

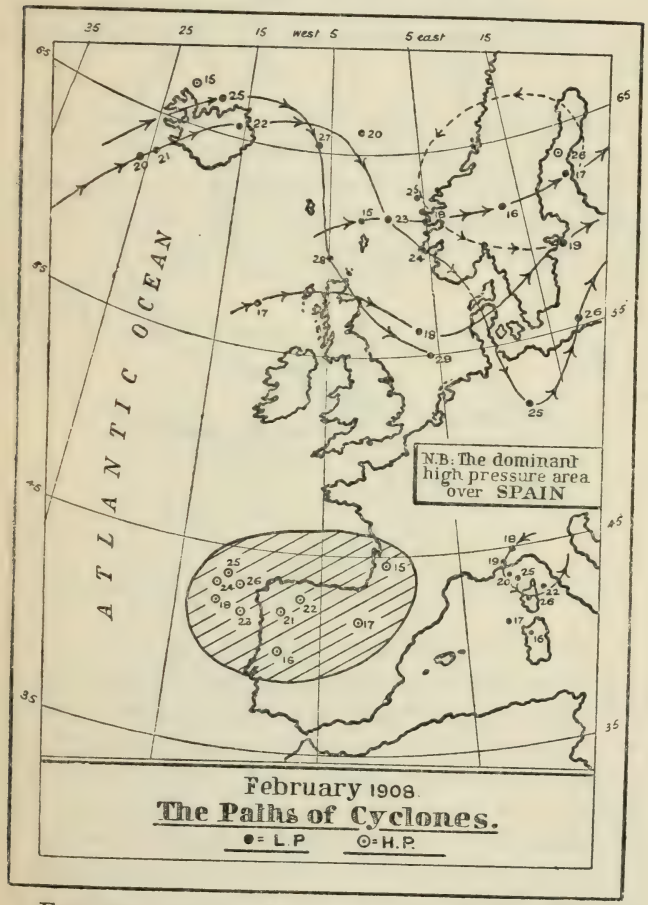


Fig. 106*a*.—Cyclone Tracks for February, 1908.*

The movement is *clockwise*, though scarcely perceptib Weather is steady and dry (*e.g.*, Spain on Fig. 106*a*).

* Figures on the tracks represent dates (not pressures) when low pressure centre was at the given point.

Cyclones are, however, irregular and local disturbances of the atmosphere; from them we turn to consider steady winds, which are of great importance to navigation, and which, perhaps, are the principal factors giving rise to ocean surface drifts.

Constant Winds.—Cyclones and anticyclones are but local and variable illustrations of widely distributed and more constant barometric conditions prevailing over the globe and depending for their existence upon the *alternation of continent with ocean* and *summer heat with winter cold.*

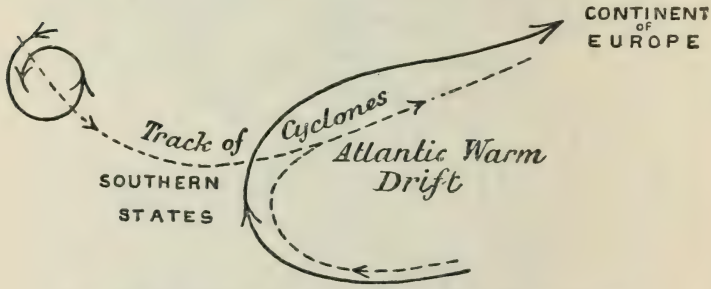


FIG. 106*b*.—TRACK OF CYCLONES IN THE N. ATLANTIC.

The *specific heat of land* is much less than that of water. The sun-heat falling upon a square mile of land produces a far higher temperature in the rocks than the same amount falling upon a square mile of sea produces in the water. The atmospheric envelope is heated by the land or water *with which it is in contact* and not directly by the sun's rays filtering through it. A simple proof of this is to be found in the fact that as we rise in still air the temperature falls rapidly. The air is warmest near the warm Earth; the Earth has absorbed the heat which falls upon it.

As a consequence, the air *above a continent* will tend to be considerably hotter under sun-heat than the air *over the ocean*, and the disparity will be *greatest in the summer.*

Moreover, it is in the summer season that evaporation is

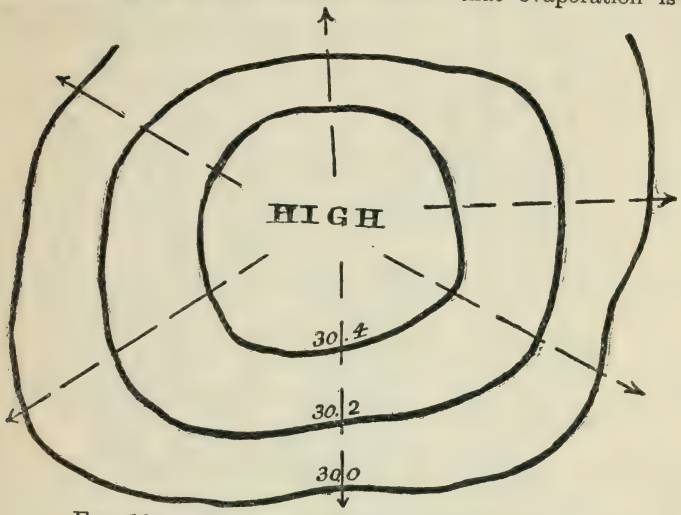


FIG. 107.—CASE OF A SIMPLE ANTI-CYCLONE.

greatest, and therefore the percentage of aqueous vapour is a maximum. It will be profitable to consider the isobars in reference to these *two factors* of (*a*) seasons, (*b*) land or water.

Summer Isobars.—Consider first barometric conditions over the Northern hemisphere in July, along with those over the Southern hemisphere in January (see Figs. 109 and 110). The following facts can be made out:—

(*a*) *Low* pressure areas are over the *Continents*.

(*b*) *High* pressure areas are over the *Oceans*.

FIG. 108. — DEFLECION DUE TO ROTATION (ANTI-CYCLONE).

These facts are more marked in the Northern hemisphere since land and water are present in more equal proportions.

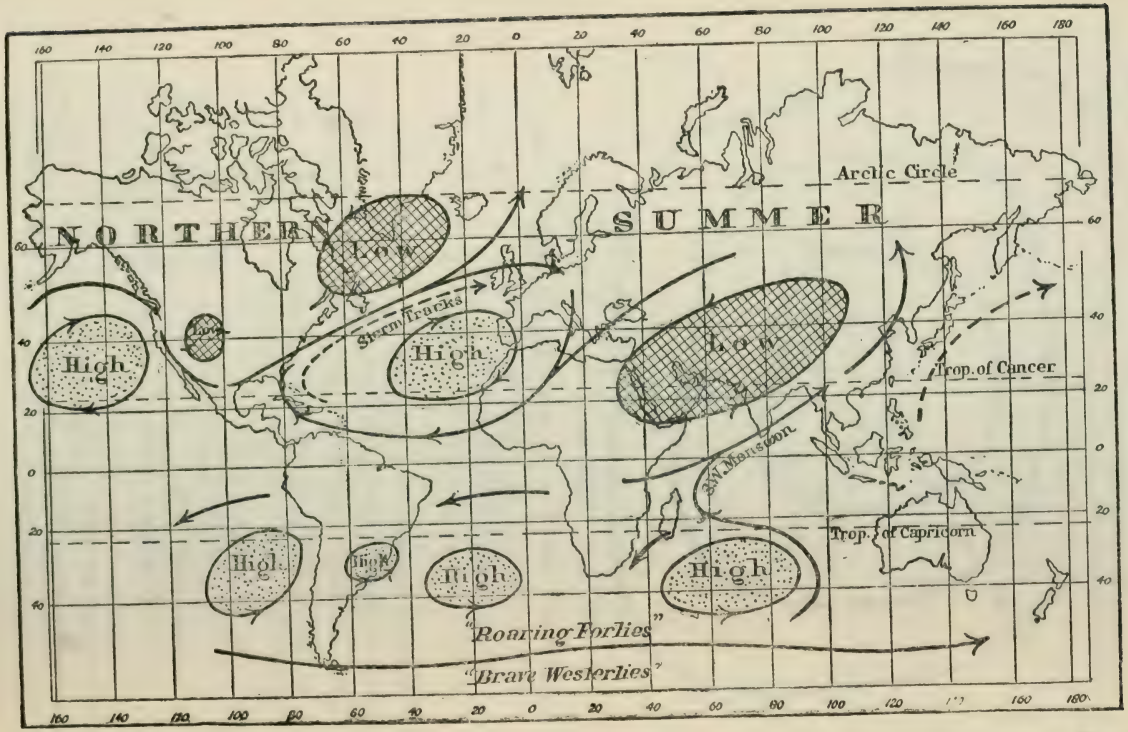


FIG. 109.—THE WORLD'S ISOBARIC LINES FOR JULY, WITH GENERAL TRACKS OF PREVALENT WINDS.

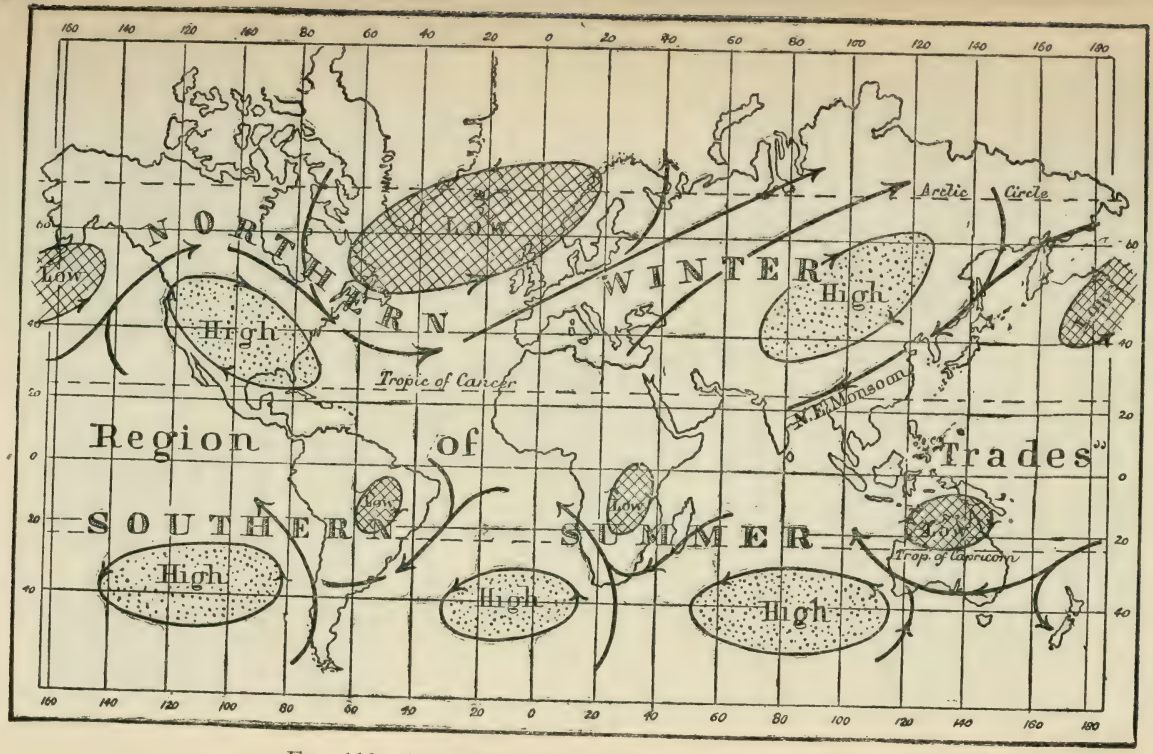


FIG. 110.—THE WORLD'S ISOBARIC LINES FOR JANUARY.

The *Low pressure areas* occur over the hottest parts of the Continents (hotter than the tropics for the time being).

(*d*) The *High pressure areas* occur in mid-ocean in slightly higher latitudes.

Winter Isobars.—A similar study of winter barometric conditions (Northern hemisphere in January, Southern hemisphere in July) yields the following facts:—

(*a*) The *Continents* are high pressure areas.

(*b*) The colder *Oceans* are low pressure areas.

The Southern hemisphere shows little change since the *amount of land outside the Tropic is very small.* It is to the Northern hemisphere that we must turn for the *full effect* of the alternation of land and water. Summarising for the Northern hemisphere we get—

	Summer.	*Winter.*
Land	Low P.	High P.
Water	High P.	Low P.

as a *general* result. Many minor facts occur to disturb this general result.

The difference seems to be due chiefly to difference of temperature of **Land** and **Water** arising from *difference of specific heat.* It would seem at first sight that excessive evaporation should produce a low barometric pressure over the sea. No doubt such is the tendency. But air circulation prevents this by carrying the aqueous vapour towards the highly-heated land* where the air tends to rise like the air over a fire. Air circulation, set up, counteracts the accumula-

* Hot air can hold a considerable quantity of aqueous vapour.

tion of aqueous vapour over the oceans, and so favours a higher barometer over the ocean; it also tends to reduce the temperature over the Continent. All this amounts to saying that *air circulation tends toward equilibrium of temperature and barometric pressure.* The laws governing these large high and low pressure areas are the same as those for local cyclones and anticyclones. The trend of air circulation over the globe is shown in Figs. 109 and 110.

The student will note that these **High and Low pressure areas lie practically outside the Tropics and within the Temperate Zone.**

Trade Winds.—Along the *Equatorial Belt* temperature and barometric pressure alike vary very little all the year round.

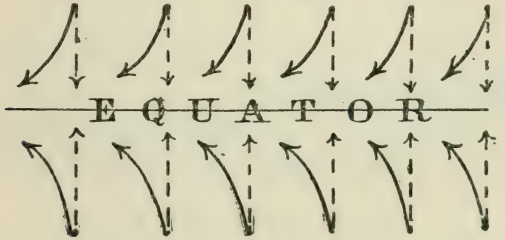


FIG. 111.—WINDS IN THE EQUATORIAL BELT.

It is here we find the *belt of calms.* The air is not *still*, but gently rising, almost vertically. The result is a steady inflow (all the year round) of air from the tropic limits. At first sight it would seem that such inflow would be from due N. and due S., as indicated by the dotted arrows in Fig. 111. The actual direction is, however from N.E. and S.E., as shown by the firm arrows in the figure. The student will at once see that the *factor of the Earth's rotation* is responsible for this westward deflection. The winds thus set up from N.E. and S.E. are remarkably *constant*, and therefore to be relied upon by navigators. The student should note that the

term Trade Winds simply means *steady* winds (winds following a trodden or beaten track).

Any variation in the trade winds is due to the shifting of *belt of calms* (called the *Doldrums*) with the seasons, when the belt of greatest heat varies as the sun is now over the northern tropic and anon over the southern. The *Thermal Equator*, or isotherm of maximum temperature, shifts from month to month.

Land and Sea Breezes.—A simple example of the parts played by land and water in producing different barometric conditions is the case of land and sea breezes at the sea-shore. The reason they are not continually experienced is that

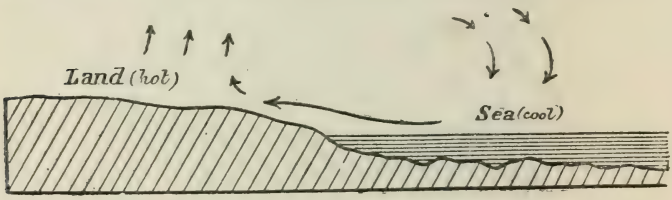


FIG. 112*a*.—SEA BREEZE (DAY).

travelling *cyclones are imposed upon local barometric conditions* and the land or sea breeze is involved in the complicated conditions. It is in "calm" weather that these local breezes make themselves evident.

Sea Breeze.—During the day the land becomes heated to a temperature considerably higher than that of the sea. The air over it expands and diffuses, tending to reduce the atmospheric pressure. The air over the sea, though gradually becoming warmer, does not expand to the same extent, and therefore the barometric pressure remains higher. Flow of air takes place from sea (high pressure) to land (low pressure).

Land Breeze.—During the night the land cools more rapidly than the water, having less heat to lose and losing it rapidly, since the rate of loss is proportional to the difference in temperature between the hot and the cold body in contact. As a result, after sunset the opposite conditions begin to set in until, after midnight, the land is at its lowest temperature (between 2 and 4 a.m.), and the sea has not cooled to the same extent. The air over the sea is warmer than that over the land, and expands and disperses upward. As a result, low pressure conditions occur over the sea, with an inflow of air from the higher pressure area over the land.

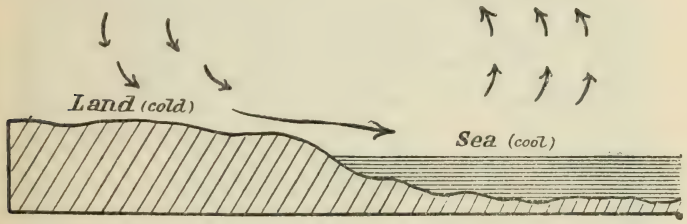


FIG. 112*b*.—LAND BREEZE (NIGHT).

Monsoons.*—The *Indian Ocean* differs from the Atlantic and the Pacific in having an enormous continental mass to the north and only just outside the Tropics. Small areas of ocean similarly placed occur *south of the Panama Isthmus* and in the African *Bight of Benin.* As a result, miniature monsoon conditions occur. It is, however, in the Indian Ocean that we find Monsoon Climate typically developed.

Case of the Northern Summer.—In June and July the Sun is almost overhead for places in the neighbourhood of the *Tropic of Cancer.* The great continent of *Asia* becomes exceptionally heated, and low barometric conditions prevail over the southern half of the continent. The ocean is an area

* Arabic: *mausim*, a season.

of high pressure. As a result, the flow of air is from ocean to continent.

The general direction of such flow must be northward, but the disturbing *factor of the Earth's rotation* produces a deflection eastward, as indicated by the firm arrows in Fig. 113*a*.- To the people of India the wind set up is a *S.W. wind*, blowing especially in the months of July and August. Having traversed a warm ocean, it is *laden with moisture*, which it deposits against the slopes of the mountains of South Asia. This gives the Rainy Season. (The influence of mountains upon rainfall is discussed in the second section of

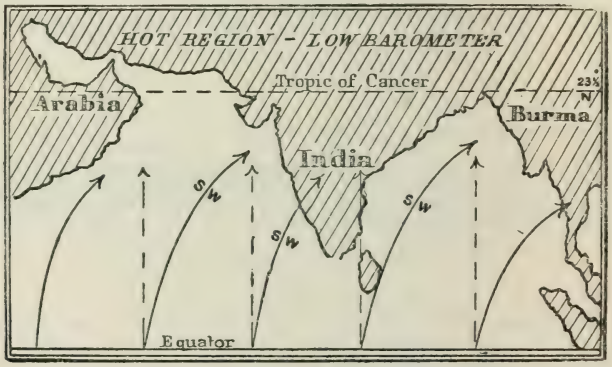


FIG. 113*a*.—THE S.W. MONSOON.

this chapter.) The student will notice that *Arabia* scarcely benefits by the S.W. monsoon.

Case of the Southern Summer.—The hot belt is now south of the Equator. In December and January the Sun is overhead in the neighbourhood of the *Tropic of Capricorn*. The low pressure area now lies over the belt of ocean from the Mauritius to New Guinea (just south of the Equator). The region of highest pressure is the *Central Asiatic Tableland*. Under such conditions air-movement at the Earth's surface (we neglect to notice the upper air movements) must be from

continent to ocean. And since the *isobars are roughly parallel to the lines of latitude*, the tendency of flow is N.—S. The *Earth's rotation* effects a westward deflection north of the Equator (since the air is moving from a comparatively slow to a comparatively fast rotating region). The result is a N.E. Monsoon set up from continent to sea. This is perforce a *dry* * and *cold* wind though it rises in temperature as it advances.

The monsoons blow fairly steadily for about two months each. The *break up of the monsoon at the Equinoxes* (March

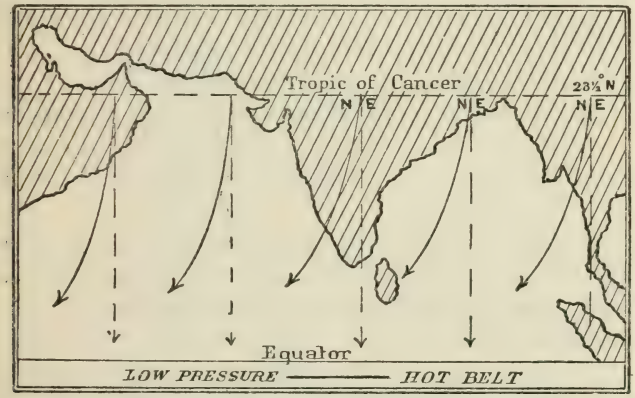


FIG. 113*b*.—THE N.E. MONSOON—LOW PRESSURE HOT BELT.

and September) is accompanied by violent storms. The Sun is overhead at the Equator and barometric changes are sudden.

Summarising the **main types of air movement** we get:—

(*a*) *Cyclones* and *Anticyclones* succeeding each other along fairly constant tracks from the tropic limit of the Temperate Zone to higher latitudes and eastward longitudes.

(*b*) *Land and Sea Breezes* (local).

* It picks up moisture on crossing the Bay of Bengal and deposits it on the eastern slopes of the Nilghiri Hills and Ceylon.

(*c*) *Trade Winds* and *Anti-trades* on both sides of the calms or Doldrums of the Equatorial Belt.

(*d*) *Monsoons*, typically developed in the Indian Ocean.

Wherever land and water alternate and temperatures vary considerably, barometric conditions will be more or less unstable, and local winds, with local names, will be experienced. The student will be familiar with the following, which deserve a passing notice:

The hot *Simoon* of the Africo-Arabian desert belt.

The *Sirocco*, from the Sahara to the Mediterranean; on crossing the Mediterranean it picks up moisture and leads to rainfall in the Dinaric Alps.

The *Föhn*, from the Mediterranean to the Alps.

The *Mistral*, a cold cyclonic wind reaching the Mediterranean from the Bay of Biscay by way of the Toulouse gap between the Pyrenees and the Cevennes.

It is worth noticing that these winds are all connected with the Mediterranean depression—where deep water conditions penetrate far into continental masses and lead to barometric disturbances.

The *Harmattan*—south of the Sahara—is similar to the Sirocco north of the desert.

The *Chinook* is a warm genial wind from the Pacific, which finds its way through the gaps of the Rocky Mountains in British Columbia, and modifies the climate of the ranching regions on the rain-shadow side of the Rockies.

Hurricanes, including tornadoes and typhoons, are violent cyclones produced by strongly marked low pressure conditions over a restricted area.

The great *importance of winds to the geographer* lies in the fact that, along with the ocean drifts, and even more markedly than they, winds act as *agents to distribute water vapour and heat over the earth's surface.* The **climate** of

a place is not fixed merely by its latitude; dampness or dryness are factors which help to determine climate; temperature is remarkably influenced by winds and the presence or absence of vapour determining rainfall. It will be well now to consider Air Circulation in reference to rainfall.

Rainfall.—A wind blowing *in from an ocean* to a continent will be more or less laden with moisture. If blowing in from cold latitudes it will bear only a small quantity of aqueous vapour but, being cold, will be near saturation point and ready to deposit as rain (or snow) what vapour it holds, if

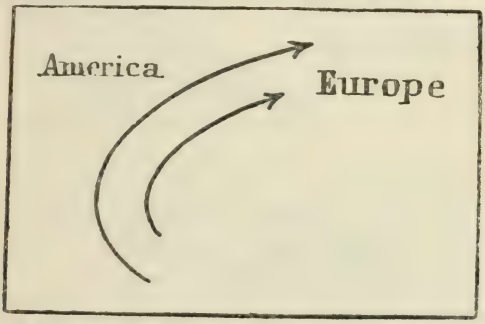


FIG. 114.—TRACK OF STEADY WINDS IN N. ATLANTIC.

intercepted by a mountain range (see p. 132). If approaching from tropic oceans, it will be soft and genial, heavily laden with moisture, and hence when condensation takes place, the rainfall is very considerable. Winds blowing *out from a continent* are of necessity dry. If blowing from cold latitudes they are exceptionally cold; if from tropical lands they are parchingly dry.

In *summer* the land is warmer than the ocean; as a result, a moisture-laden wind tends less to drop its moisture than in winter, when the land is colder than the sea. Here we have the explanation of the fact that rainfall (outside the tropics) is greater in winter than in summer. In the *tropics*, temperature *varies little* throughout the year. Evaporation is fairly

constant all the year round. Summer rains predominate over winter (if we may speak of winter) rains, because of greater evaporation.

The *direction of the prevailing winds* from an ocean to a continent is an important factor in deciding the *distribution of rainfall* of the continent. Thus, in the Atlantic, north of the Tropic of Cancer, the European seaboard is more influenced by rain-winds (**Fig. 114**) than are the American coast

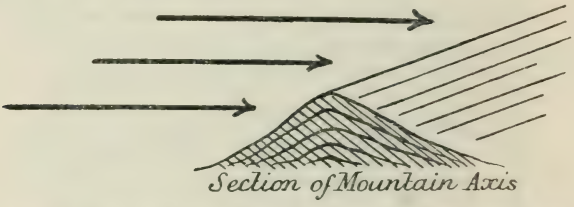


FIG. 115.—RAIN-BEARING WINDS STRIKING A MOUNTAIN FLANK.

lands. (We noted in Chapter V. that the same was true of the influence of ocean drifts). Similarly, in the Western Hemisphere, Pacific North America benefits more than does the Archipelago of Japan. And instances might be multiplied.

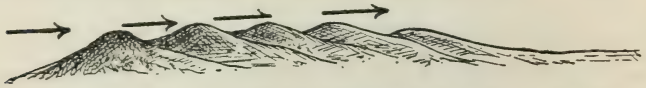


FIG. 116.—RAIN-BEARING WINDS SKIRTING A MOUNTAIN FLANK.

The student has only to consult a map of winds to see which seaboards have the advantage on every continent.

Influence of Mountains upon Rainfall.—A second factor in the distribution of rainfall is the *relative position of highland axes* to the wind direction. Let the axis be at right angles to the direction of the wind; the influence is considerable (**Fig. 115**). Let it be similar in direction to the wind movement; the influence is negligible (**Fig. 116**). When a

moisture-laden wind strikes broadside the flank of a mountain range, the air is forced up into higher (and, as we know, colder) altitudes. The warm wind could carry the moisture without condensation. But in the upper regions of the air it is cooled, and condensation is probable (Fig. 117). The amount of condensation will depend on the extent of cooling. It follows, therefore, that the chances of condensation are greater when a wind surmounts a *high* range than when it traverses a *low* ridge. Thus the conditions most favourable for heavy condensation are:

(*a*) Ocean wind from tropic latitudes.

(*b*) High mountain axis *normal* to the incoming rain-wind.

The student will do well to verify this for each continent, making his own sketch map in each case on the lines of Fig. 118 for Africa.

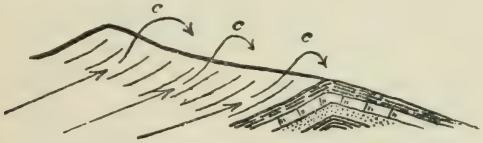


FIG. 117.—MOUNTAINS AFFECTING RAINFALL.

Rain-Shadows.—The seaward side of a lofty mountain range is often exceptionally rainy, whilst the landward slope is remarkably dry. Such a dry slope or region has been very appropriately named a *rain-shadow* area. They are most marked in *extra-tropical* latitudes. Striking examples occur in:—

(*a*) The Canadian *Rockies*.

(*b*) The *Patagonian Axis* of South America.

(*c*) The Northern *Kiolen Axis* of Scandinavia.

(*d*) The *Himalayas* of India.

(*e*) The *Southern Alps* of New Zealand.

The same feature, in modified form, is met with in nearly every mountain range near the ocean border. The wind has

been tapped in ascending the seaward slope, so that it is far from saturation point after crossing the summit. Descending the landward slope (see Fig. 117), it is approaching lower and *warmer* layers of the atmosphere, and so is less and less

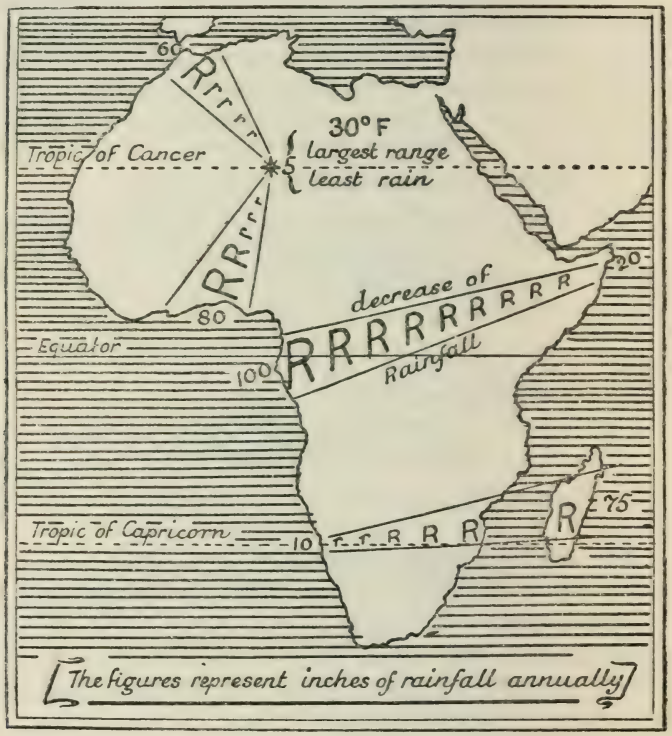


FIG. 118.—AFRICAN RAINFALL.

likely to condense.* A *ring fence* of mountains, such as we get in Australia and the north of Africa must, if the above conditions hold, enclose a *dry interior*. The Sahara and

* In the same way a wind blowing towards hotter latitudes over a continent is less and less likely to drop its moisture, since heat increases the capacity for holding moisture.

the Australian bush are sufficiently striking examples. The "Great Basin" of the Rockies is an American illustration.

Tropical Rainfall.—Mountains will have less effect in the Tropics since very high altitudes are necessary to yield condensation. Hence the influence of mountains is less than that of wind direction. The map of Africa shown on p. 134 illustrates this point very remarkably.

Rainfall on a Plain.—In the absence of mountain obstacles, rainfall diminishes gradually as we recede from the ocean to the Continental Interior.

Influence of Rainfall on Temperature.—Rainfall has great influence upon the temperature at a given place. A comparison of the rainfall map with that of annual range of temperature brings out the fact that *wide range* between summer and winter average temperatures is found in areas of exceptionally *low rainfall*; minimum range is associated with maximum condensation. The tendency is for rainfall to temper summer heat and winter cold, preventing wide differences of temperature between summer and winter.

Condensation liberates the *latent heat* in the aqueous vapour.

In *winter*, condensation takes place in the lower layers of the atmosphere, which are cold. Rain implies a liberation of heat into the cold air, and evaporation is low because of the lowness of the general temperature.

In *summer*, on the other hand, condensation occurs in the upper cool layers and the rain falls through the lower warmer layers. In its passage the cool rain from cool heights tends to be evaporated in the descent through warmer layers; evaporation produces cold (the reverse process of condensation, heat that becomes latent being extracted from the air), tempering thereby the heat of the summer's day.

The student will now be prepared to see that the tempera-

ture of a given place is not decided by the simple statement of its latitude. *Ocean-drifts*, *winds* and *rainfall* are some of the modifying factors which result in belts of equal heat not coinciding with belts of latitude, and in some positions of such a belt having a wider range between summer and winter temperatures than others.

This brings us to the study of the distribution of heat over the Earth's surface. *Isothermal maps* are most helpful in such a study.

Isothermal Maps.—An isotherm is the *locus* of all places having the same average temperature. The period for which

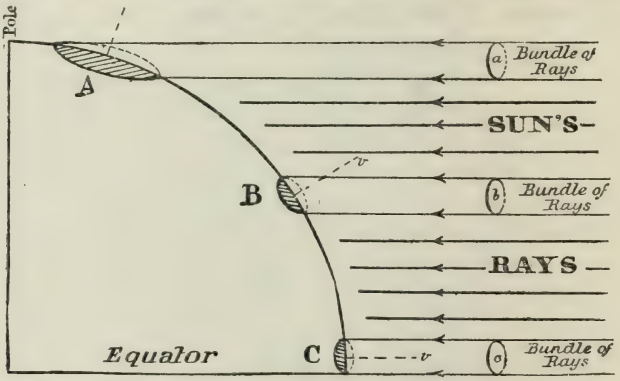


FIG. 119.—VARIABLE DISTRIBUTION OF HEAT OVER THE EARTH'S SURFACE.

(*The diagram illustrates one of the Equinoxes.*)

the average is taken is usually a month, and the months chosen for illustration in geographical atlases are the hottest and the coldest—July and January (N.H., *vice versâ* for S.H.). A yearly average is also useful, though for climatic types a map showing *annual ranges* between summer and winter averages is more valuable.

The isotherms engirdle the globe in some sort of rough parallelism to the lines of latitude. Variations can be traced

as due to modifying factors such as are mentioned above. If the Earth were merely a homogeneous solid with no enwrapping hydrosphere (ocean) or atmosphere, the isothermal lines would coincide in direction with the latitude lines, and temperature would be distributed solely according to latitude. Indeed, in the *southern hemisphere*, where an ocean engirdles the Earth, such a state of things practically exists. Any variation is due to *currents* and minor *land masses*.

Temperature as affected by Latitude.—Consider Fig. 119:

a, *b* and *c* are **equal** bundles of sun's rays approaching the Earth.

c falls practically vertically upon the *small* area C.

b falls on a somewhat *larger* area B.

a falls on the *extensive* area A.

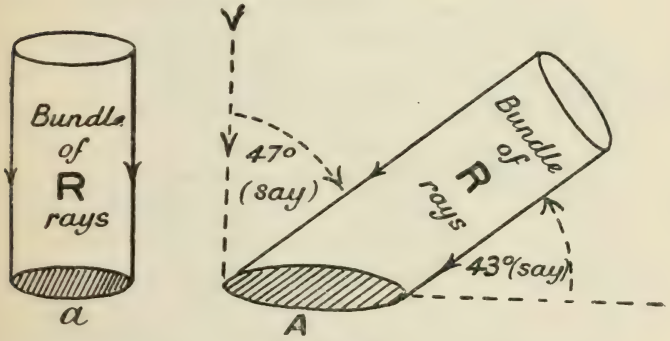


FIG. 120.

[Diagram to illustrate loss of heating-effect with obliquity of rays. The same number of rays (R) falls upon the small area (*a*) as upon the much larger area (A), hence (*a*) becomes much more heated per unit area than (A).]

The same amount of sun-heat is falling on each area, therefore C will be heated more than B, and much more than A per unit area. Therefore the temperature of the air, *heated by the earth*, will be considerably higher at C than at A.

A study of the diagram will reveal that the decrease of temperature, as we move towards the pole, is *not in arith-*

metical ratio to the distance from the Equator; the decrease is really in *trigonometrical ratio*, the mathematics of which is outside the scope of a textbook of geography.

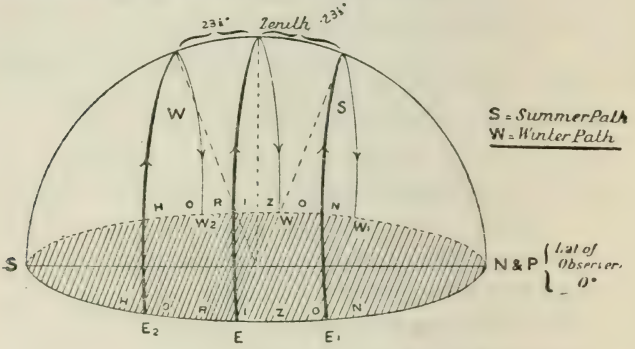


FIG. 121.—CASE OF OBSERVER AT THE EQUATOR.

E_1W_1 = path of sun across the sky on June 21st.
E W = " " " Sept. 23rd aed March 21st.
E_2W_2 = " " " December 22nd.

Note similarity for *June* and *December* (S. and W.)

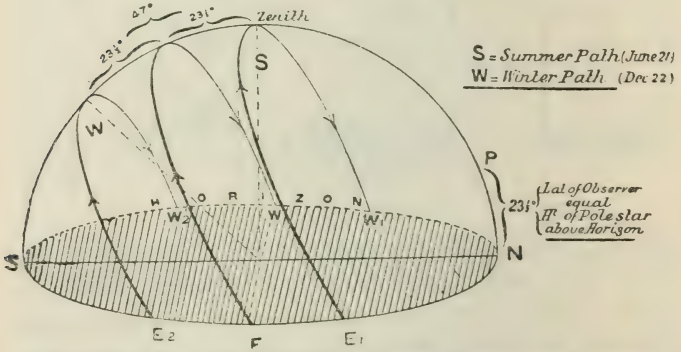


FIG. 122.—CASE OF OBSERVER AT THE TROPIC OF CANCER.

E_1W_1 = path of sun across the sky on June 21st.
E W = " " " Sept. 23rd and March 21st.
E_2W_2 = " " " December 22nd.

Note *dissimilarity* for *June* and *December* (S. and W.)

[The student should draw the diagram for the *Tropic of Capricorn.*]

The vertical is shown in each case. The *relation of heating power to verticality* of rays is brought out by the diagram, and is further illustrated in Fig. 120.

The diagram is too simple, however, to explain *actual* conditions for, owing to the *obliquity of the earth's axis* and the *translatory motion* of the Earth in its orbit, the verticality of the sun's rays varies from season to season—only a little for places within the tropics, and considerably more for places outside the Torrid Zone. Thus at the Equator the obliquity of rays varies only $23\frac{1}{2}°$, whilst *at* and beyond the lines of Cancer and Capricorn it varies 47° (twice $23\frac{1}{2}°$=twice obliquity of the earth's axis). These variations correspond to *variations in length of day*. It is clear then that even the question of latitude affecting temperature is not so simple as Fig. 119. might lead the student to assume.

Modifying Factors.—It will be well, at this stage, to summarise the chief *disturbing factors* which determine the non-correspondence of isothermal belts with latitude zones:

1. Warm and cold ocean drifts.
2. The different thermal capacities of earth and water.
3. The circulation of the atmosphere.
4. The irregular distribution of rainfall.
5. The regional variation in altitude of the earth's surface.

These by no means exhaust all the factors; *local* factors, peculiar to any given region, are omitted.

We may now proceed to consider the July and January Maps, and the Range Map derived therefrom:—

July Isotherms—*Northern Hemisphere.*

January Isotherms—*Southern Hemisphere.*

i.e., Summer Isotherms.

The following points are important:—

(*a*) Isotherms are very irregular in the hot belt between the Equator and Lat. 40° N.

(*b*) In the Temperate Zone the trend of the belts is as indicated in Fig. 123.

Let *xy* be a parallel of latitude. Then places on the continent north of *xy* are as warm as places on the ocean

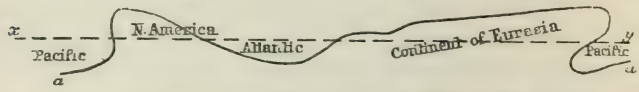


FIG. 123.—NORTHERN HEMISPHERE (SUMMER—JULY).

south of *xy* or, put in another way, we may say that **in summer**:

For a given latitude *Land is warmer* than latitude warrants, whilst *Water is colder*.

The student can verify the same for the Southern summer

FIG. 124.—SOUTHERN HEMISPHERE (SUMMER—JANUARY).

Map (Fig. 124). The variation is not so marked, because land and water are not so irregularly arranged.

January Isotherms—*Northern Hemisphere.*
July Isotherms—*Southern Hemisphere.*
i.e., Winter conditions.

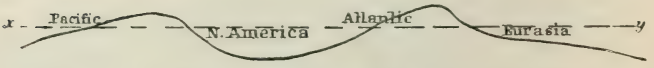


FIG. 125.—NORTHERN HEMISPHERE (WINTER—JANUARY).

Fig. 125 shows the trend of isotherms and their enclosed belts for the Northern Winter. This time, places on the continent south of *xy* are only as warm as places in the ocean north of *xy* or, put in the other way, we say, **in winter**:

For a given latitude *Land is colder* than latitude warrants, whilst *Water is warmer*.

Fig. 126 illustrates the map for the Southern Winter (July), and points to the same truth as Fig. 125. The prime cause of these results is evidently the different thermal capacities of land and water already dealt with in the early part of this chapter. The student will remember that the Equator is North of *xy* in Figs. 124 and 126.

The eastward direction of the crests of the curve deserves a passing notice. If the student will consider the flow of warm

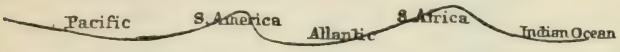


Fig. 126.—Southern Hemisphere (Winter—July).

ocean drifts he will note that the general drift is in the direction of the arrows in Fig. 127. The drifts carry heat into higher latitudes, and so affect the trend of the isothermal curves.

The *hottest regions* in the world in July, when the Sun is in Cancer, are *dry plateaux in the latitude of the tropic*-boundary—the Great Basin of *Colorado*, the *Sahara-Soudan* North African Interior, the desert belt from *Arabia* to *Thibet*. Similarly in January, when the Sun is in Capricorn, the *poles of greatest heat* are on the dry tablelands of the *South African Veldt* and the *Australian North-West*.

Bays of cold project from the Arctic Zone southward over the Canadian fur-lands and the Siberian tundras — *Verk-*

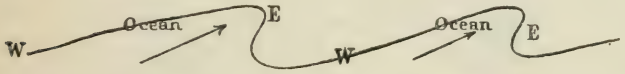


Fig. 127.—Effect of Ocean Warm-Drifts on Isotherms.

hoyansk being the pole of greatest cold on the earth's surface in January, when the thermometer average for the month is −50° F or 82° of frost. In the middle of the night temperatures 90° F below freezing point are registered.

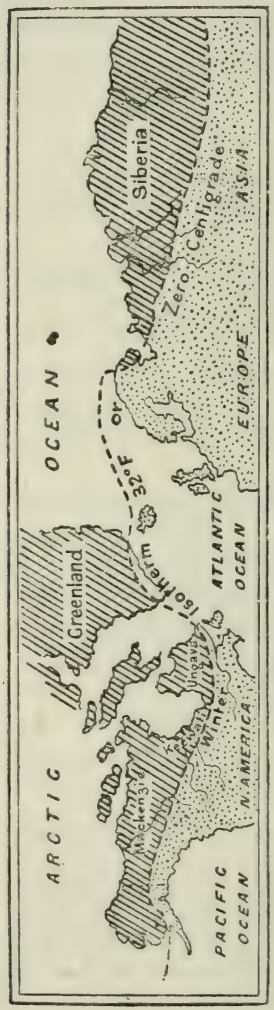


FIG. 128.—THE GEOGRAPHICAL ARCTIC ZONE.

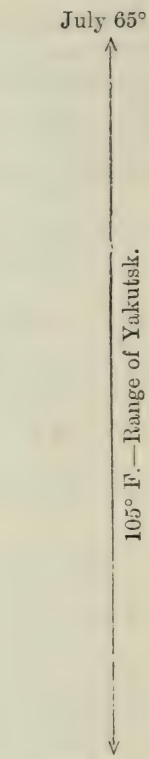


FIG. 129.—RANGE OF TEMPERATURE.

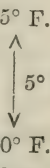


FIG. 130.—CASE OF SAMOA.

Annual Range of Temperature.—The most interesting and instructive of all the isothermal maps to the geographer is that showing the *annual range of temperature* for each region of the globe. For, apart from tropic, temperate and arctic classification of climate, there is the grouping of climates as Continental or Insular, or, in other words, extreme or equable. This double classification may be illustrated in a table as follows :—

	Extreme.	*Equable.*
Arctic.	1. Arctic, with seasonal extremes.	4. Arctic equable.
Temperate.	2. Temperate, with seasonal extremes.	5. Temperate equable.
Tropic.	3. Tropic, with seasonal extremes.	6. Tropic Equable.

Such a table gives us *six fairly defined types* of climate. The student should note the use of the word *extreme* in the above classification. A spot having *very hot summers* (considering latitude) followed by *very cold winters* experiences a climate of extremes. The mean annual range of temperature is very considerable; the isotherm for summer is many degrees higher than that for winter. Another spot has little difference between summer and winter temperatures, the summer isothermal reading is *very few degrees* removed from that of the winter. Such are examples respectively of an *extreme* and an *equable* type of climate.

Take two striking examples. *Yakutsk*, the capital of Siberia, has comparatively hot summers (as warm as North France, 65° isotherm—July), whereas it is almost the coldest place in the world in January (−40° F.=72° F. degrees of frost. The *mean annual range* is thus 65+40 degrees=105°F. (climate of extremes).

Samoa, the island home of the late Robert Louis Stevenson, has less than 5°F. difference between its summer and winter isotherms (equable climate).

The table shows that equable climates are *not confined to one zone*, nor are extreme types. But a study of the map will show that *equable* types are associated with oceans and ocean-margins, hence the alternative term *insular*;* whilst *extreme* types are more closely associated with *continental* interiors away from oceanic influence, *e.g.*, the Canadian North-West and Asiatic Russia, in the belt of most land.

The equalising effect of the ocean and the winds blowing in from it, is thus brought home to the student. Even more striking is the *close connection between rainfall and the mean annual range.* A careful comparison of the rainfall map with that of annual range of temperature brings out the following facts:—

1. Low rainfall and great range (*extremes*) are associated.
2. Dense rainfall and small range (*equable*) are associated.

(See Fig. 131.)

The extreme ranges on the *southern continents* only reach *30°F.* difference between summer and winter; those on the *northern continents* reach *80°F.* on the smaller mass of North America and the enormous difference of *120° F.* at the focus of the Eurasian mass.

We at once see that ranges of temperature are:—

(*a*) On the whole wider in colder latitudes than in warmer zones.

(*b*) Most extreme on the large land masses.

Places in high (cold) latitudes have *long summer days and short winter days*, which accounts for the *considerable range;* places in the equatorial belt vary little all the year round in the matter of relative length of day and night; which fact explains to some extent the *smaller range* on the southern continents, and especially of the equatorial belt. It will be seen from the close connection between rainfall and range in Fig. 131 that *rainfall is the chief agent in equalisation* for all latitudes, tending to reduce the range in both high and equatorial latitudes. Thus the *Atlantic border of Europe* has

* Lat. *insula*=island.

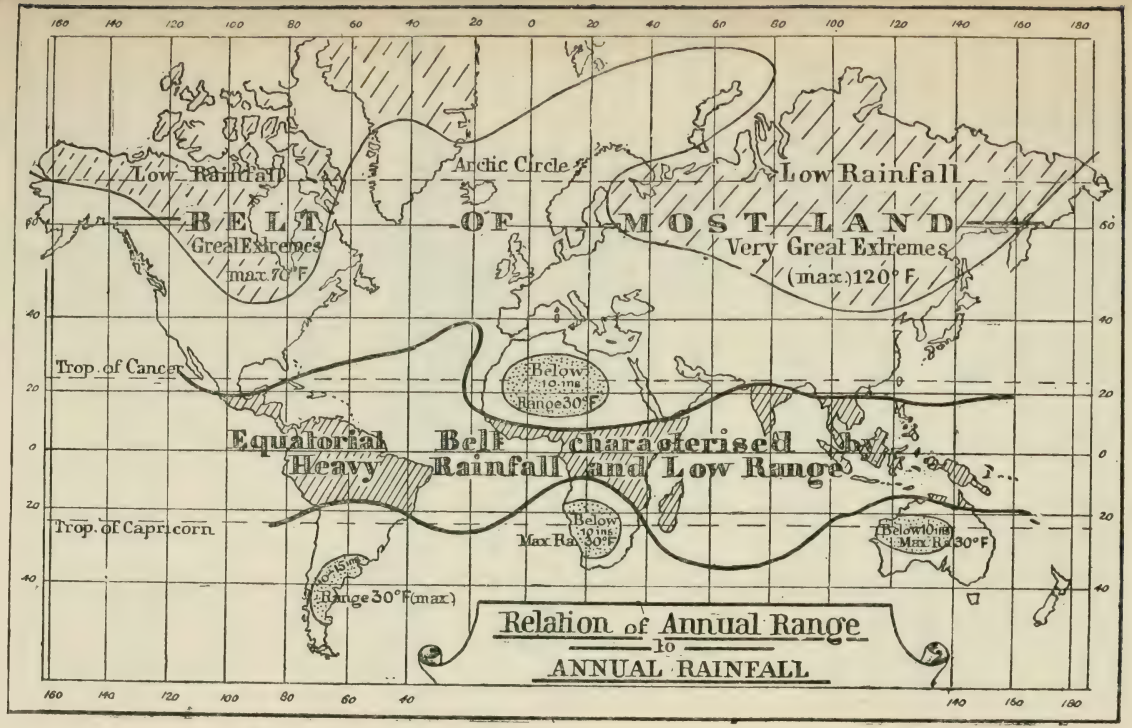


FIG. 131.—RELATION OF ANNUAL RANGE TO ANNUAL RAINFALL.

a lower range than any part of the drier interior. *British Columbia* has a small range compared with *Manitoba*, on the dry "rain shadow" slope of the Rockies. *Florida*, with its heavy rainfall has a range of 20°F., whereas the *Sahara* exceeds 30°F. range in its driest areas. We are now in a position to consider climatic units, classified on the lines of the following table:—

	Extreme (continental.)	*Equable (insular).*
ARCTIC.	*Arctic*: with low rainfall, very long summer days, very short winter days, and wide seasonal extremes.	*Arctic*: with much rain, very long days, very short winter days, warm ocean drifts, and warm winds—reducing extremes.
TEMPERATE.	*Temperate*: with low rainfall, hot long summer day, cold short winter days, and seasonal extremes.	*Temperate*: considerable rain, long summer days, benefiting by warm drifts and winds.
TROPIC.	*Tropic*: with low rainfall, nearly equal days, hot summers and warm winters.	*Tropic*: rainy belt, nearly equal days, summer heat tempered by rains—range very small.

If the rainfall is distributed throughout the year it still more tends to equalise summer and winter conditions. Thus the equatorial belt marked on Fig. 131 has two rainy seasons, summer and autumn, further securing equable conditions over the year.

The world's climatic units are considered in detail in Chapter VIII.

See Appendix for an exercise on Local Winds and Rainfall.

CHAPTER VII.

Catchment-Areas and Drainage Types; Rivers and their Importance to Agriculture, Intercourse and Transit.

Of the rain which falls upon the land, part sinks into the ground, percolating by gravitation to lower and still lower levels, until an impervious stratum is reached; the direction of movement is then along this stratum in the direction of its downward slope. A point of emergence may or may not be reached. Many such points occur on the sides of

Fig. 132.—Springs on a Hill Side.

valleys (*see* Fig. 132) or along fault-planes. The water issuing at any given point is called a spring.

If the student carefully studies the figure given above he will see that a spring at (*a*), the lower end of the slope, will be larger and more constant than one at (*b*). The latter will flow only when the porous cap is saturated to the saturation-level indicated. Its flow is fitful, and therefore

it is called an intermittent spring. The older text-books of physical geography did not adopt this simple explanation, which serves to cover the majority of such springs; they used an exception as the type, such as is common only in limestone or other easily-soluble rocks. In many lime-

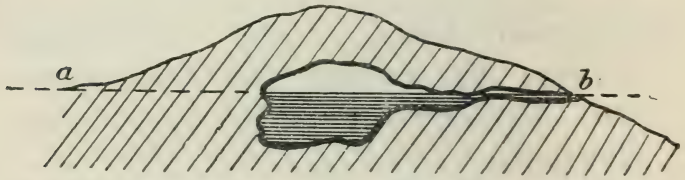


FIG. 133.—AN INTERMITTENT SPRING IN A LIMESTONE HILL.

stone masses hollows occur, somewhat after the fashion illustrated in Fig. 133. It is clear that only when the percolating water more than fills the hollow to the level *a*—*b*, will there be an overflow at (*b*). Such intermittent springs do occur, but they are not of the common type.

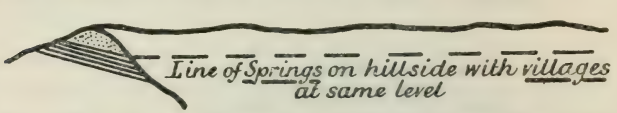


FIG. 134.—LINE OF SPRINGS ON HILL SIDE WITH VILLAGES AT SAME LEVEL.

Fig. 134 shows a hill-flank corresponding to the section given in Fig. 132.

The springs along the hill side will occur at the line of outcrop where the porous cap lies in contact with the impervious bed. The importance of springs as water-supplies will naturally lead to farms clustering about the springs at the level of issue. Farms grow into hamlets, hamlets into villages. Thus a line of villages is ranged along the hill side, and the turnpike road connects them.

The percentage of rain-water which sinks into the ground will depend upon the nature of the surface rocks. Porous

rocks like chalk and loose sand absorb nearly all the rain that falls upon them. The country in such a case dries up quickly after a rain-storm. Slaty rocks, clays and hard crystalline surfaces on the other hand allow of very little percolation, except along joint-planes. In such cases the water flows off the slopes quickly in full streams and stands for a considerable time in the hollows on the lower lands. The plains are liable to floods and marshes, unless artificially irrigated. This is in striking contrast to the very porous English chalk with its dry valleys and underground streams.

Since rain water is slightly acid, the water issuing at a spring after slow percolation through a series of strata will be charged with mineral matter in solution, the nature of the matter depending on the character of the strata.

Lime bi-carbonate is the commonest compound in spring and river water, simply because limestone is more soluble than the other *commonly occurring* rocks of the earth's crust, sandstone, clay, lava, granite. Exceptional rocks give rise to exceptional qualities in the spring water. Thus we get magnesian waters, iron waters (chalybeate), sulphur waters, gypseous waters, potash and soda waters.

Waters containing a comparatively large percentage of carbonate of lime are designated hard; those containing a low percentage, soft waters.

The quality of the water has its commercial importance. Hard waters demand a large use of soap in the cleansing processes used in manufactures. Soft waters are economical in manufacture, both in the washing of fibres and the dyeing of fabrics. Many natural waters have medicinal properties, as at Harrogate, Wiesbaden, Marienbad.

Some waters are better adapted for brewing purposes than others (gypsum in Burton springs is a case in point).

Sandstones like the New Red Sandstone of England and the Old Red Sandstone of Scotland and Wales are valuable as

storage for water. Wells are easily made and prove of great value.

Artesian wells deserve notice at this point. In a basin of gently folded strata, where pervious and impervious layers of sediment alternate we have the conditions for an artesian well. These conditions were first noted at *Artois* in the Paris Basin.

They have since been developed in many regions where the stratigraphical conditions obtain and are termed Artesian (*i.e.*, Artoisian) wells (*see* Fig. 135.) Our own Thames valley at London affords an excellent example of the suitable conditions.

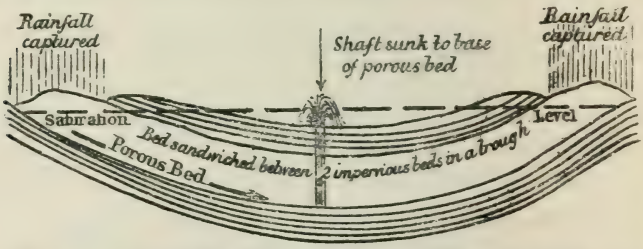


FIG. 135.—DIAGRAM SHOWING CONDITIONS FAVOURABLE TO THE BORING OF ARTESIAN WELLS

The London Clay and the Gault are impervious layers. Between them is sandwiched the very porous Chalk and Greensand, a series of considerable thickness.

The chalk emerges in the Chilterns on the north side of the basin and in the North Downs on the southern edge. Rain falling on these ranges will find its way by gravitation to the trough-bend in the Chalk under the London clay. This will be saturated and the line of saturation on each side of the valley will stand high. If an outlet is afforded by a shaft sunk through the London Clay to the Chalk, but not through the Gault layer, mere hydrostatic pressure will force the water stored in the Chalk out by way of the shaft until the saturation-

line sinks to the level of the mouth of the shaft. This is of course only theoretically accurate; friction would interfere with such exact action.

Artesian wells are proving of immense value in those sheep-farming regions of the Australian interior and the S. African Veldt, where droughts are dreaded.

Altered conditions above the Snow-line. Icefields and Glaciers as Sources of Rivers.—At a certain height in the atmosphere the temperature is that of the freezing point of water; above that altitude the temperature is still colder; any precipitation must therefore be in the nature of snow, or ice, or hail. Where mountains are so lofty as to reach those altitudes, their surface will be subject to successive falls of snow. As these falls of snow accumulate one upon another, the underlying portions will harden by pressure into ice. Pressure, too, will give a tendency to melt.

On steep slopes the snow cannot readily accumulate; it slides down the slope to a terrace, a cirque,* or a valley in the form of an avalanche.

In upland basins there forms a sea of snow and ice (as at *Eismeer*, a station on the projected Jungfrau Railway), with loose freshly-fallen snow on the surface and compact ice below, melting to some extent by the pressure from above. Such are the features of an icefield. The material is called "*firn*" (Ger.), or "*névé*" (Fr.). Through the eismeer (icefield) rise the comparatively bare peaks of the range [*aiguilles* (Fr.), or *horns* (Ger.).]

After a time accumulation becomes so great that the eismeer overflows, and the firn or névé pushes its way down the valleys, which open out from the upland basin. In this way a glacier (ice-river) is formed, and projects like a tongue of ice into the verdant valley some distance below the snow line. Glaciers move almost imperceptibly slowly;

* A natural amphitheatre in a group of hills.

their movement is obscured by the melting away of the tip of the tongue of the glacier, so that the front seems no further advanced from day to day. Careful observations, carried on over a period of years, show that glaciers advance in periods of excessive precipitation and refrigeration, and that they "retreat" in periods of low precipitation or genial climate.

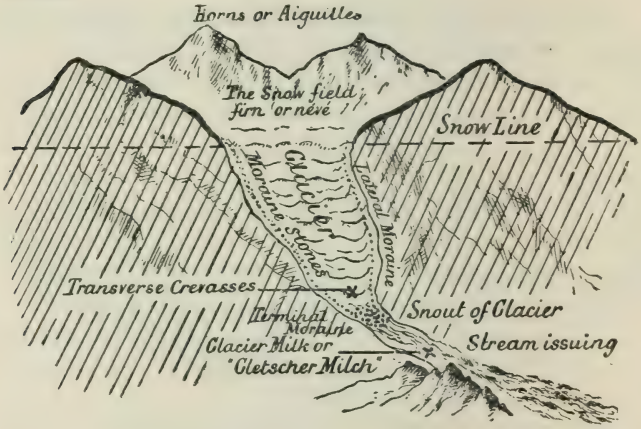


FIG. 136.—ORIGIN OF A GLACIER.

The student must be careful to understand that the ice itself does not retreat, *i.e.*, move backward up the valley; it is merely that the front of the glacier melts faster than the ice-mass advances. In the same way, an advance is due to the ice front advancing faster than melting can counteract. Ice is very brittle, and any movement of the ice-mass over a rugged surface must lead to fracture in the glacier. This is especially noticeable in a steep, rocky valley. The fractures extend transversely across the glacier, and are so deep in many cases as to reach the rocky bed beneath the ice. The surface of a glacier is therefore much more uneven and dangerous to traverse than a snowfield. Intersecting fractures give rise to ice-pinnacles (*séracs*).

Frost is a great disintegrator of rock-masses, and much stone and loose mud fall from the slopes, the "aiguilles" or "horns" upon the eismeer, or glacier, at their foot. Thus the sides of a glacier are fringed with lines of heaped up stones and mud. The two lines coalesce at the snout of the glacier, and since the ice is constantly melting (being farthest below snow line) mud and gravel accumulate in great quantities. The fringing lines are called *lateral moraines*, the terminal heap is called a *terminal moraine*. Two glaciers coalescing in a common valley give a *median moraine* in addition.

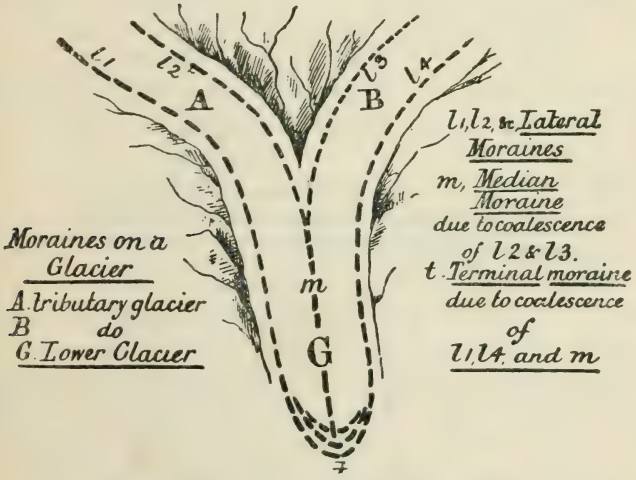


FIG. 137.—FORMATION OF MORAINES.

In high altitudes there is usually a large range of temperature between midday and midnight. The sun's rays fall upon the surface of névé and glacier, and melting follows. The water flows on the ice till it tumbles into a chasm in the ice, and finds its way to the floor of the glacier. It follows an under-ice course till it reaches the front of the glacier. Here it emerges and mingles its

waters with those of the melting front of the glacier. Such water is milky in appearance, since it carries much detritus in suspension. It goes by the name of *gletscher milch* (glacier milk) in the high Alps.

Glacier-fed streams not only carry heavy loads of detritus; they are also remarkable for their constancy of flow. Summer suns cause much melting; winter snows lead to increased accumulation, increased pressure, and a pushing of the ice-tongue down into the warmer reaches of the valley. Many of the world's finest rivers rise back in the ice-fields of some lofty mountain range. The Indus and the Ganges are examples from the snows of the Himalayas. The Rhine and the Rhone are European examples, rising within a few miles of each other on the Bernese Alps. The Mackenzie River and the Saskatchewan have their sources in the snows of the Rocky Mountains. The Nile draws much of its water from the snowy heights of Ruwenzori. Even Australia has its perennial snows in the Kosciusko region of the Australian Alps, which feed the Murray, the most important of her rivers.

The line on a mountain slope above which snow is constantly found is the "*snow-line.*" This differs from a general line for summer and one for winter much in the same way that the ordnance datum line differs from high water mark and low water mark. But it differs from that standard line in that it is of different altitudes in different latitudes, and even on the two slopes of the same range. In Arctic latitudes it descends nearly to sea level and glaciers end in icebergs. On the Equator it stands at about 16,000 ft., and only a few peaks wear a cap of snow (*e.g.*, Mt. Kenia in East Africa). In the Northern Hemisphere the snow-line stands higher on the southern slope of a range than it does on the northern flanks.*

Catchment Areas and Drainage Types.—The water emerging from springs, and that which immediately flows off the land,

* The opposite is the case S. of the Equator.

gathers into streams, and these run together to form a main stream, which carries off their joint waters to some sea or lake. The area served by one such river is called a catchment area. The meaning is obvious. From his knowledge of the different types of surface configuration in various parts of the land masses of the globe, the student will expect that catchment areas differ in type.

Ranges, plateaux, valleys, basins, inland plains, and coastal sills give rise to many types of drainage area.

Ranges have usually a long and a short slope, and give rise naturally to long and short streams, the former often in parallel series (*cf.* Sweden), the latter mere torrents dropping by waterfalls from ledge to ledge (*cf.*, Norway.)

Waterfalls had their place in the development of the machine industries at the end of the nineteenth century. The early factories sought their "power" from water-wheels.

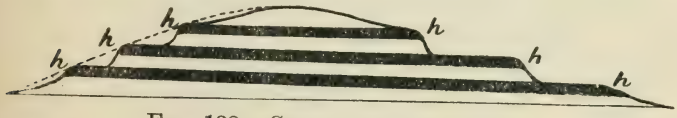


FIG. 138.—SECTION ACROSS A HILL.
h, *h*, etc.,=hard outcrops forming rock ledges, over which streams leap as waterfalls.

Many waterfalls are brought into requisition in the generation of electricity for "power" purposes (*e.g.*, Niagara Falls; Victoria Falls on Zambesi).

Waterfalls can be divided into two classes—

(*a*) Rushing torrents dropping over the sheer heights of some mountain mass.

(*b*) Broad falls interrupting the steady flow of a river from its upper reaches to the lowland plain.

Type (*b*) is common in tabular hills, where stratified rocks occur in horizontal or gently tilted layers. Denudation, acting upon hard and soft strata, sculptures the hillside into step-like terraces. The streams leap over the hard, projecting ledges as beautiful waterfalls. A "fall-line" is noticeable along the

flanks of a ridge much in the same way as the line of springs referred to earlier in this chapter. The falls in the Yorkshire dales are of this type. A fall-line is very noticeable in the Atlantic streams of the Eastern States of the U.S.A., and is marked by a series of towns along it (*e.g.*, Raleigh in North Carolina and Augusta in Georgia).

Parallel ranges give rise to inter-mont valleys and inter-mont streams, usually with no room to develop tributaries of any importance. A common case is that of an inter-mont valley with streams taking opposite directions in the two halves of the valley (*e.g.*, the upper reaches of Indus and Brahmaputra). This is especially so in young folded ranges like the Himalayas and the Alps.

In ancient ranges like the Appalachians, the lateral streams of one valley often cut back into the next interior valley and tap the waters of its stream. Such action repeated gives rise to a zig-zag valley like those in Pennsylvania, British Columbia and Burma.

FIG. 139.—RIVERS IN PARALLEL VALLEYS.

The "grain" of a plateau often gives rise to parallel streams like those of the Spanish Meseta.

A rift-valley of necessity gives rise to a straight-flowing stream poor in tributaries (*e.g.*, the Jordan).

A mountain-group or dome sets up a radial series of streams which after reaching the plain follow its slope towards the sea. This often necessitates one stream compassing the base of the whole group before finding an outlet to the sea (*cf.*, the Severn, the Eden).

Types may be multiplied to any extent, being as varied as the typical land forms.

Professors Israel Russell and W. M. Davis have invented

the terms **consequent, subsequent** and **obsequent** in application to the different characteristics of streams going to make up the drainage system of a catchment-area.

Consequent streams are those whose existing courses were consequent upon the configuration of the country, when first it emerged as dry land.

Subsequent streams are those developed subsequently to the consequent streams, and result from the revelation, under

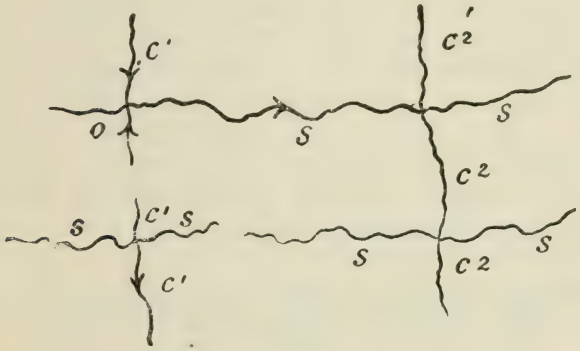


FIG. 140.—A COMPLEX RIVER-SYSTEM.

C.—The original streams over the slope (consequent streams).
S.—Streams developed as result of unequal weathering of hard and soft rocks (subsequent streams).
O.—An obsequent stream. (A part of C_1 captured by *S*, a tributary of C_2).

prolonged denudation, of the geological "grain" of the land surface.

Obsequent streams are portions of an original consequent stream captured by the development of lateral streams to a neighbouring river.

A simple figure will illustrate these terms.

It will be noted that *O* is an obsequent (flowing backwards) stream, occupying the channel of a former consequent stream, but now draining in an opposite direction as the valley of the subsequent stream deepens The tributary which meets it at

the confluence, coming from the opposite side is still a consequent stream, since it keeps its original direction of flow, though it drains to a new outlet. Thus in the London Basin, the Thames between Oxford and Reading is the main consequent stream. It and its tributaries from the Chilterns and the Downs are consequent streams due to the emergence of a V-shaped estuarine trough above sea level.

Denudation has given rise to the streams which run axially along the Weald and to the Upper Thames and Great Ouse draining the clay troughs at the foot of the Chiltern scarp. Such streams are subsequent. They mostly join the consequent streams as tributaries. The Great Ouse is pushing its source further and further back until one day it will tap the waters of the Cherwell. As its valley deepens backwards, the Upper Cherwell may resolve itself into two tributaries of the Great Ouse, a consequent remnant from the northern slope and an obsequent stream from the south.

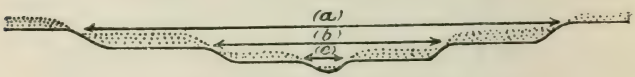


FIG. 141.—RIVER TERRACES.

The Thames valley serves to illustrate another interesting feature of river-action, viz., the *formation of river-terraces*.

These terraces are covered with river gravels and represent former *flood-plains* of the stream: (*a*) is the oldest and broadest, belonging to the earliest period of the river's history. The slope of the land must have been very slight and the river has meandered over a broad flood-plain covering it with alluvium; (*b*) and (*c*) represent later stages with smaller flood-plains due to more rapid flow of the stream.

In hilly countries where a torrent emerges suddenly upon a plain or open valley, the sudden check to its velocity reduces its detritus-carrying power and a delta-shaped river-cone or fan of alluvium is deposited at the valley mouth.

In such a case we get converging streams, slow moving and deep, with the ideal conditions for water transit within the broad region. The Mississippi, the Amazon, the Volga, and the Ob are of this type. The conditions are not ideal in any one case. An outlet to an inland sea (Volga) or a frozen ocean (Ob) makes the best of rivers only valuable for internal commerce. Terraces and deep-cut valleys in soft sediments spoil the western feeders of the Mississippi. Impassable tropical forest and jungle leave the Amazon basin ill-developed. Floods hamper the Hoang-ho and gorges and rapids the Yangtse River.

No great river is simple in type, but composite. The **Nile** affords an excellent example of a composite stream. Its sources are respectively in the narrow lakes of a rift-valley and the broad lake of a plateau. An upland basin is fed by uncertain streams. Two large feeders bring their quota to swell the river in the rainy season from many converging streams in the volcanic uplands of Abyssinia. The life-giving river traverses a desert belt without a tributary, carrying the waters of far distant highlands to the Mediterranean Sea, and depositing a rich load of silt to build up a delta—one of the richest in the world and the home of one of the world's greatest civilisations. The **Indus** has many points in common with the Nile. The fertile Punjab, a land of many streams, and the barren desert of Thar; the intermont valley on the plateau of Thibet, and the gorges of Kashmir all go to make up an interesting composite catchment area. The **Colorado** has carved its way deep into the rainless plateau, having obtained its waters far back in the snows and rains of the Rocky mountains. *Canons* are typical of rivers traversing rainless territory. The river has sawn its way down into the plateau, but no weathering back of the sides of the ravine has accompanied the process. In rainy regions, the weather cuts back the slopes, whilst the river cuts down

into the plateau. The varying rainfall of different regions thus gives rise to differing types of valley.

Here again the student must beware of the simplicity of diagrams. Differences of texture and arrangement in rocks are disturbing factors.

Amongst the hills, in upland valleys, rivers are chiefly valuable as water-supplies. Where the hills are rich in metallic ores, the use of the water for steam purposes and for hydraulic power, as well as for generating electrical

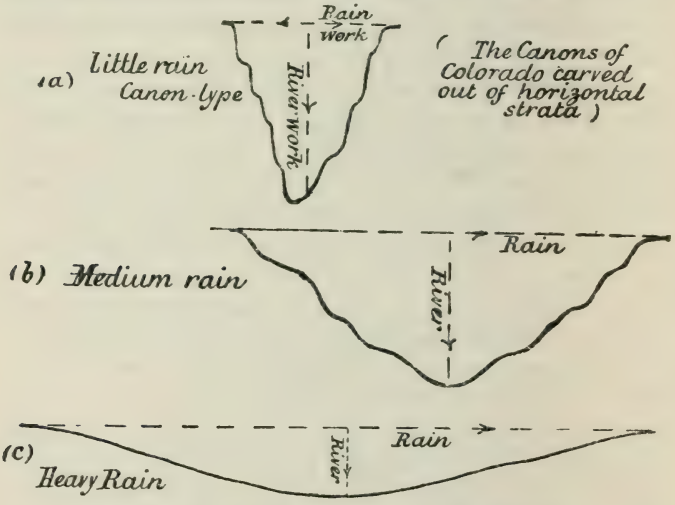


FIG. 142.—THREE TYPES OF VALLEY-EROSION.

energy, is very valuable. In timbered regions, rafts may be floated down to the lowlands.

The valleys themselves may be of immense strategic importance, even when the stream is not of value (*cf.* N. W. India; the Dora Baltea in the Alps). They also form "lines of least resistance" for roads and railways crossing the uplands (*e.g.*, Crow's Nest Pass, the Aire Gap, the Kloofs of Natal, the Reuss and Ticino valleys of the Alps, the Morava valley of the Balkan Peninsula.)

It is on the lowlands that rivers serve as commercial highways and so as means of commercial intercourse. In the lower regions of valleys the course is fairly direct to the seaboard; over a broad basin or open plain the river is likely to meander, and so, serving many regions, to lose in directness of communication with its seaports.

In these lower regions of the drainage area the river flows more slowly, and tends to drop its load; in this way it fills up its bed and, when the rainy seasons occur, overflows its banks. In flood-time the river bears the greatest proportion of silt; each flood, therefore, deposits fine silt over the surrounding plain. In this way the many fertile flood-plains of the world have been built up. To avoid flooding, the river is often banked in with dykes. As the generations pass, the bed and the banks necessarily rise until the river flows on an embankment (levée) at a level considerably above that of the surrounding country. Such is the case in the Lower Mississippi region, the "fens" of the Rhine-Maas delta, and the lower course of the Po. To utilise the flood water and its valuable silt, irrigation channels are constructed to control the distribution of the surplus waters over the cultivated plain (*e.g.*, the Ganges, the Lower Nile, the Yangtse River).

Rivers banked in as suggested carry their fine silt out to the mouth and build up a delta, either *palmate*, as in the cases of the Nile and Ganges, or *digitate*, as in the remarkable delta of the Mississippi. The direction of the tidal flow largely determines the formation of the river outlet. Strong tides inflowing directly towards the river mouth and ebbing along a line which is a continuation of the river course scour the mouth and give a valuable tidal river or estuary.*

Tides striking obliquely have a proportionately less effect.

The relation of force of outflow to the tidal opposing force determines whether the deposit shall be a mere *bar* or a

* L. *Æstuarium*=pertaining to the tides. The student should study a map of co-tidal lines.

wide-spreading sand and mud bank, called a delta from the resemblance in form to the Greek letter Δ. Across such a triangular bank the main stream breaks up into numerous distributaries, none of which may be of service to navigation. If the river itself is of sufficient value as a commercial highway, then one or more distributaries is deepened and kept open for traffic by continual dredging. The huge delta of the Danube is an example in point. The Nile outlets are the Rosetta and Damietta distributaries. The Hugli is the chief distributary of the Ganges outlet. It is surprising how many of the world's great rivers terminate in deltas. We expect deltas in comparatively tideless seas like the Mediterranean and the Caspian, but we are scarcely prepared for such huge deltas as those of the Mississippi, the Niger, the Indus and the Ganges in seas open to full tidal influence. It is worthy of note how many of these huge deltas are in tropical latitudes, where rivers are fed by tropical rains.* Many rivers of little importance have been made valuable by simply dredging their channels, to allow of the inflow of the tide. The Tyne is a remarkable instance. People are still living (1908) who remember fording the Tyne from Newcastle to Gateshead when they were boys. Dredging has made the Tyne one of the most valuable waterways in the world. The tide fills the river twice a day to a point a few miles above the city of Newcastle. The Clyde is an even better example. Paisley has become a port for vessels of five to eight thousand tons burden, simply by making a channel for the admission of the tide.

Other river-mouths form natural harbours and waterways. The Thames, the Elbe, the Mersey, the St. Lawrence will occur to the student.

Gorges offer obstacles to navigation of one kind, shallows obstacles of another kind. One may take that very valuable

* Sea-water is exceptionally dense in tropical latitudes, and for this reason helps the deposit of silt.

highway, the Danube, as an example. Between Vienna and Budapesth it expands into shallows. Above Vienna it cuts its way through the Linz gorge. Below Belgrade it negotiates a wilder ravine (Iron Gate) through the Carpathian wall Its delta we have already noted.

Yet the value of the highway has made engineering works, whether of dredging or blasting, worth undertaking. Canalisation is often used to overcome the disadvantages of a generally useful river. Thus the waterfall of Niagara is overcome by the Welland Canal; the rapids of Sault St. Marie are avoided by using the "Soo" canals. The difficulties of the Iron Gate in the Carpathians are overcome by canals.

A network of valuable rivers may be linked up by uniting-canals. The German plain affords an example, whilst the Siberian rivers afford an excellent opportunity.

The great waterways of the world are familiar to the student.

Canada has the St. Lawrence; the States have the Mississippi system and the Hudson River.

Europe has the Volga and the Danube, the Elbe and the Rhine.

South America possesses the Amazon and the Plate River.

Africa has been opened up by way of her rivers, the Nile, the Niger, the Congo, and the Zambesi.

Asia has the southward draining Indus, Ganges, Irawadi and Mekong; and the eastward-flowing Yang-tse-kiang. The majestic rivers of Siberia drain to an ice-bound ocean, whilst that other great river of the Russian Empire, already mentioned under Europe, drains to an inland sea.

Australian rivers are of little value as highways.

Lakes.—We have left the consideration of lakes and their relation to river systems so that we may give them special notice. They offer almost as many types as do mountains and river-systems. Lakes are exceedingly numerous over

the lowlands of what in the Ice Age were glaciated regions. Finland, Sweden and the Hudson Bay depression are covered with lakes of this type. Their formation seems to be due to the distribution of morainic matter left by the disappearing ice.

Ribbon lakes are common in the radiating valleys of mountain-knots (*e.g.*, English Lake District, Alps). They often fill the upper valleys of parallel streams emerging from a highland axis (*e.g.*, west of Scotland, Bothnian Sweden).

Lakes of inland drainage, with no overflow, form another common and important type. They are associated with steppe-lands, salt basins and desert fringes, *i.e.*, with regions of low rainfall. Lake Chad in West Africa, and Lake Rudolf in East Africa; the Caspian and Aral Seas of the Russian Empire; Lob Nor on the plateau of Thibet; the Dead Sea of Palestine; Lakes Eyre and Torrens in the Australian interior and the Great Salt Lake on the American Cordillera are well known examples.

Evaporation keeps pace with or exceeds inflow, so that in the end the lake becomes a salt lake. If its waters are fresh, the lake is probably of comparatively recent origin. Sven Hedin thus argues with regard to Lob Nor. Lake Chad is not very salt.

The Great Lakes of Canada present a striking resemblance to those of N.W. Russia. They are economically of much greater value owing to their relation to the wheatlands of the interior and the St. Lawrence highway. They lie 10° further south than those of Finland. Storms equal to those of the Atlantic arise on the Canadian Lakes (Superior has an area as large as Ireland).

The filling up of a fresh-water lake gives rise to a fertile strip of country; the dessication of a salt lake may leave a valuable deposit of salt.

CHAPTER VIII.

Geographical Units: a more detailed Study of Contrasts and Similarities on the Continents.

[Maps to be studied: Mercator's Map; Orographical Maps; Isobaric and Isothermal Maps; Rainfall and Vegetation Maps.]

We have seen in a previous chapter how latitude, configuration, and proximity to or distance from the seaboard determine climate by determining rainfall and temperature range; and we are now ready to define a climatic unit. The principal climatic types have been classified in Chapter VI. Before proceeding to notice the close correspondence between a physiographical unit, a climatic unit, and a more complex geographical unit, it will be well to pause and observe the characteristic types of vegetation associated with each type of climatic unit or province.

If the student will carefully compare his Rainfall, Range, and Vegetation Maps he will be impressed with the following facts:—

(*a*) Deserts are found to coincide with areas of *rainfall below 10 ins.* and a range of more than 30°F., *i.e.*, dry mountain-walled interiors, and especially plateaux (*e.g.*, *Sahara*, *Australia*, *and Colorado*). The range is greater for the deserts of the Temperate Zone than those of the Tropics.

(*b*) TUNDRAS skirt the Arctic seas, where *rainfall is slight* because *little evaporation* takes place, owing to the *average temperature* being low and the ocean being covered with ice (Arctic seaboard).

(*c*) GRASSLANDS WITHOUT TREES occur in the dry basins contiguous with the desert uplands, in which the *wide range* between summer and winter, as well as the lack of water, is unfavourable to tree life. Such grasslands serve for sheep farms (*e.g.*, The Veldt (Veld), Darling Downs), or in the temperate zones for wheat farms (*e.g.*, Manitoba, South Russia). The long, hot days of summer ripen the grain and the land lies fallow during the severe winter. The *sheep farms* occupy the *drier* portions, whilst the *grain lands* cover the area of somewhat *heavier rainfall.*

(*d*) MIXED WOOD AND GRASSLAND (greener grass than that of the treeless prairies) cover the belts of *medium rainfall* in the Temperate Zone (*e.g.*, European plain), whilst the park-like *savannah* country is characteristic of tropic tablelands (*e.g.*, East Africa), where rainfall is not excessive, and annual range is not great enough to be detrimental. Evergreens are characteristic of the hotter climes, deciduous* trees of the temperate belts, coniferous trees of the colder latitudes.

(*e*) TROPICAL FORESTS cover the areas of heaviest rainfall within the Torrid Zone. Oil- and rubber-yielding trees and creepers are the most characteristic (*e.g.*, Congo basin, Amazon basin).

(*f*) The slopes of mountain ranges in the Temperate Zone are clothed with forests of deciduous trees (*e.g.*, Walds of Germany). Rainfall is considerable, and the soil, being ramified with rootlets, retains much water; but excess of water drains off.

* Lat., *De*=down, *cado*=I fall: referring to the leaves in winter.

(*g*) *Coastal plains* are usually unfavourable to forest growth, especially in the Tropics.

(*h*) *Conifers*, with resin cells, are capable of survival through the winter frosts of the colder temperate belt (*e.g.*, Sweden, Finland, Quebec). They are also associated with mountain slopes having considerable rainfall (*e.g.*, Pinhal Real, Portugal).

(*i.*) Arctic conditions prevail at *snow line* on lofty mountain slopes, with the result that zones of vegetation follow in sequence with increasing altitude much as they do with increasing latitude* (*e.g.*, Mexico, the Alps, etc. See Fig. 143). *Mountain flora* of moss and lichen suggest the Arctic flora on the edge of the tundras belt.

FIG. 143.—ZONES OF CLIMATE OF MEXICO, WITH CORRESPONDING BELTS OF VEGETATION

Natural vegetation and fauna determine, in the first instance, the course of primitive human industry in any given area. Hunting and trapping come first, then forests are cleared before farms are planted, so that lumbering precedes tillage. Grasslands, if climate is favourable, come quickly under the plough, and serve as the world's granaries; or, if too dry for grain, serve as sheep farms or cattle ranches; in warmer climes the ostrich is reared on farms. The savannahs

* Day and night do not vary in the same way, however, so that Arctic conditions are not *exactly* reproduced.

of the tropics are the home of big game; crocodiles infest the rivers. The impassable tropical forest, made so by the creepers or parasitic undergrowth which grow up around the boles of the tall forest trees, is now yielding its rich resources to the world's commerce. The creepers yield rubber, which comes from the latex; * the tall trees are the oil palm and nut-bearing trees, whose nuts, when crushed, afford valuable oil.

Agriculture precedes *mining*, and is more dependent upon physical features and climatic conditions of range of temperature and rainfall.

We may now consider a definition of a geographical unit under the four inter-related aspects of physical features, rainfall, annual range of temperature, and vegetation.

A **geographical unit** is an area over which similar conditions of physical feature, rainfall, annual range of temperature, natural vegetation, and possibilities of agricultural development prevail. This precludes the presence of dominant contrasts. The neighbouring geographical units on a continent are of necessity areas presenting contrasts with it and with each other.

The fundamental difference is one of physical configuration, modifying climatic possibilities due to air and ocean circulation and astronomical causes. In this chapter we have ventured to construct maps of the continents showing geographical units. The student is warned against supposing that no other classification of units could be made. He must take them for what they are worth as suggestions for a system of geographical classification, and discover how far they accord with the general scientific principles considered in the foregoing pages of this book.

* L. *latex*=liquid, juice; sap.

THE THREE NORTHERN CONTINENTS.

[Offering many comparisons with each other and contrasts with the Three Southern Continents.]

The Pacific seaboard is similarly placed to the Atlantic countries of Europe, though in the wider ocean the warm drifts and ocean winds drive in from the west rather than the south-west.

The Rocky Mountain wall is a most important climatic barrier, owing to its interception of the rain-bearing west winds which blow in from the Pacific. The student has only to compare the map of annual ranges of temperature with that of annual rainfall to discover that the regions of extreme range are those of low rainfall, whilst those of minimum range are regions of maximum rainfall. The long slope from the Rockies to the Hudson Bay is a typical "rain-shadow" area, comparable in range (60°F) and climate with the plain of South Russia, and is the most continental in type on the North American continent. Only Siberia—on the larger continent of Eurasia—has a more extreme climate. The rainy slope of the Pacific, a comparatively small distance away, extending from San Francisco to Sitka, has but an average range of 20°F.

The outstanding fact of the extreme continental climate of the north is further explained by reference to the great *variation in the length of day* in regions of high latitude. The Great North-West of Canada has long, dry days in summer, followed by equally long nights in the winter, *i.e.*, extremes of duration of sunshine—the maximum period affording great heat, the mid-winter minimum resulting in extreme cold. In the southern states not only rainfall, but a roughly *equal distribution* of sunshine throughout the year, serves to explain the equable or insular nature and low range of the climate.

Two regions of North American climate remain to be noted. The first of these is the practically *rainless region*

of the Great Basin, enclosed between the Cascade Range and the Rockies of the western States, which, in July, is one of the three *hottest regions of the world*, considerably hotter than the equator itself. The sun is directly over the Tropic of Cancer on Mid-summer Day, but the land mass—so susceptible to heat, and in this particular area untempered

Latitudes.	Equable.	Intermediate Types.		Extreme.
Arctic.		Yukon Basin.	The Mackenzie Basin. The Hudson Bay Depression. The Plateau of the Great Lakes.	The Arctic Islands.
Temperate.	Alaska. British Columbia.	The St. Lawrence Valley. New England States. The Snake River Plateau.	The Wheatlands and Food States of the Upper Mississippi. The Rain Shadow of the Rocky Mountain Flanks.	The Wheatlands of the Canadian Interior. The Colorado Great Basin.
Tropic.	The Cotton States. Fertile California. The Lower Mississippi. The Mexican Coast-lands.	The Ohio Valley.	The Mexican Plateau.	

Table of Geographical Units.—North America.

by rainfall—draws the area of extremes still further north until the region of greatest heat falls almost *outside the tropics.*

The second of these two regions, the coastlands of the North-West Passage—so long the allurement and the despair of explorers, but in 1906, for the first time, navigated with

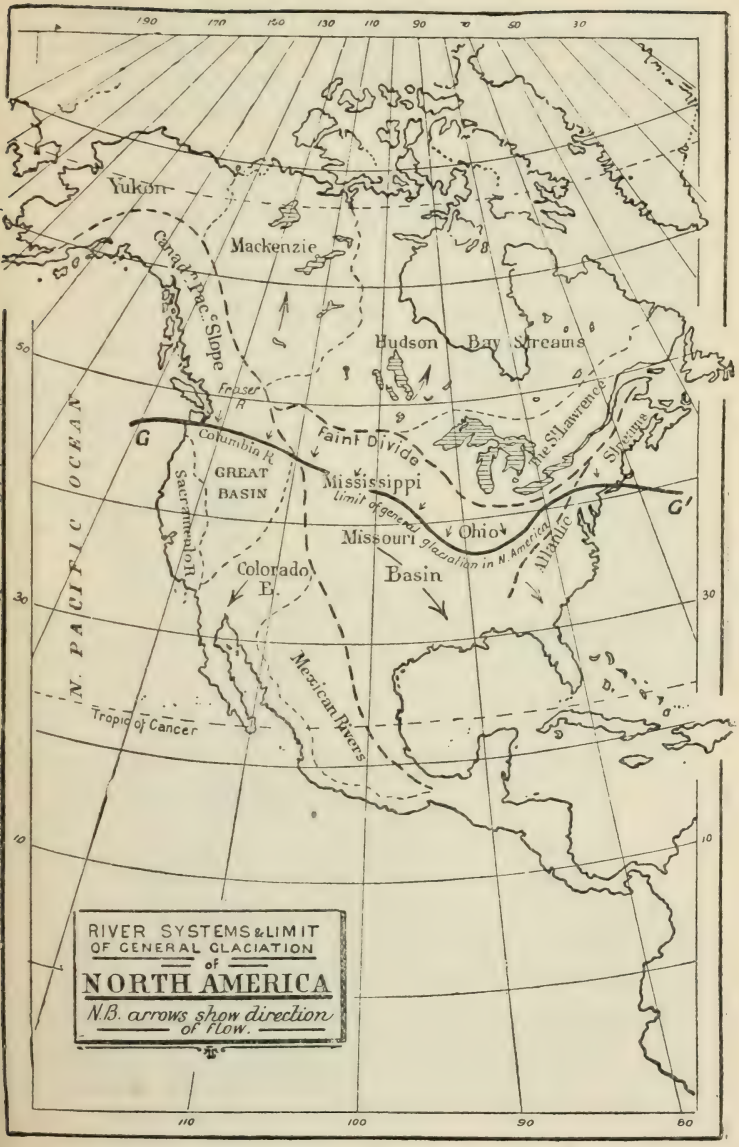


FIG. 144.—GEOGRAPHICAL UNITS OF NORTH AMERICA.

success—lies in the area of extremest winter cold on the Continent. The region is a bay of polar climate projecting southward over Canadian territory, even beyond the Arctic Circle, and colder than Spitzbergen, which lies 10° nearer the Pole.

Influence of Sea on Climate.—A map showing *mean annual ranges* of temperature over different districts of Europe shows the influence of the neighbouring ocean in producing equable conditions of climate (Scandinavia, British Isles, Brittany, Portugal). The Basin of the Volga, remote from the ocean, affords the nearest approach to a continental climate. Western Russia and the plains of the Baltic Basin

Latitudes.	Equable.	Intermediate Types.		Extreme.
Arctic.	Arctic Norway.		The Bothnian Arm of the Baltic.	White Sea Depression.
Temperate.	The British Archipelago.	The Netherlands.		
		Paris Basin.	German Highlands.	The Plain of Russia.
	Brittany.	Alps.	Bohemia.	
	The Biscay Basin.	Rhone Basin.	Hungary.	The Euxine Depression.
		Po Basin.	Danubian States.	The Caspian Depression.
	The Atlantic Border.	The Adriatic Depression.		
			The Balkan Peninsula.	The Spanish Meseta.
		The Western Mediterranean.		

Table of Geographical Units.—Europe.

experience a medium range. Holland, Belgium and North France are more equable, but cool; South France, Spain, Italy and Greece are fairly equable, and warm.

Climatic Provinces.—It is, therefore, no difficult matter to divide Europe roughly into climatic provinces, each having its own distinctive type of climate, and its consequent agriculture, whether of lowland plain or upland slope.

FIG. 145.—BROAD CLIMATIC UNITS OF EUROPE.

Europe and North America.—Having now reviewed the climatic and agricultural features of Europe, it is interesting to make a few comparisons with North America. These all point to more favourable conditions of climate in Europe than in America east of the Rockies. The climate of the Baltic is comparable with that of the great lakes rather than with that of the Hudson Bay—in the same latitude. Indeed,

Latitudes.	Equable.	Intermediate Types.		Extreme.
Arctic.				The Siberian Shore-lands.
Temperate.		The Japanese Archipelago.	Basin of the Amur.	The Siberian Interior.
		The Rivers of China.	The Altai Plateau.	Deserts of Pamir and Gobi.
		Asia Minor.	The Aralo-Caspian Depression.	The Roof of the World. (Shaded on the map.)
		The Euphrates Basin.		
		The Levant.	The Iran Plateau.	
Tropic	The Plains of India.	The Deccan.		
	The East India Archipelago.	Indo-China.		Desert of Thar.

Table of Geographical Units.—Asia.

the Hudson depression can be compared only with the White Sea region of Europe. The wheat and grass lands of the Dominion experience a similar climate to that of the wheat and wool districts of South Russia. The Atlantic seaboard of Europe is comparable only with the Pacific seaboard of America, *i.e.*, the west coast in each case (influenced by ocean currents). The Southern States of the Union correspond to the Mediterranean type.

FIG. 146.—GEOGRAPHICAL UNITS OF ASIA.

THE THREE SOUTHERN CONTINENTS.

The student will notice the predominance of Tropic Types and the comparative absence of Arctic and Cold Temperate Types. Deserts, too, are common to all three continents in

Latitudes.	Equable.	Intermediate Types.		Extreme.
Tropic.	The Caribbean Depression.			
	The Basin of the Amazon.	The Brazilian Plateau.	The Basin of the Orinoco.	
	The Peruvian Seaboard.			
Temperate.			The Parana-Paraguay Valley.	The Small Atacama Desert.
		The Chilian Seaboard.		
			The Rain-shadow Slope of Patagonia.	
Arctic.		The Falkland Group.		

Table of Geographical Units.—South America.

the same Latitude, *viz.*, that of the Tropic of Capricorn. South America offers many comparisons with Central and South Africa; Australia with South Africa rather than with Central, though North Australia offers points of resemblance to Rhodesia and the Zambesi plateau and shorelands.

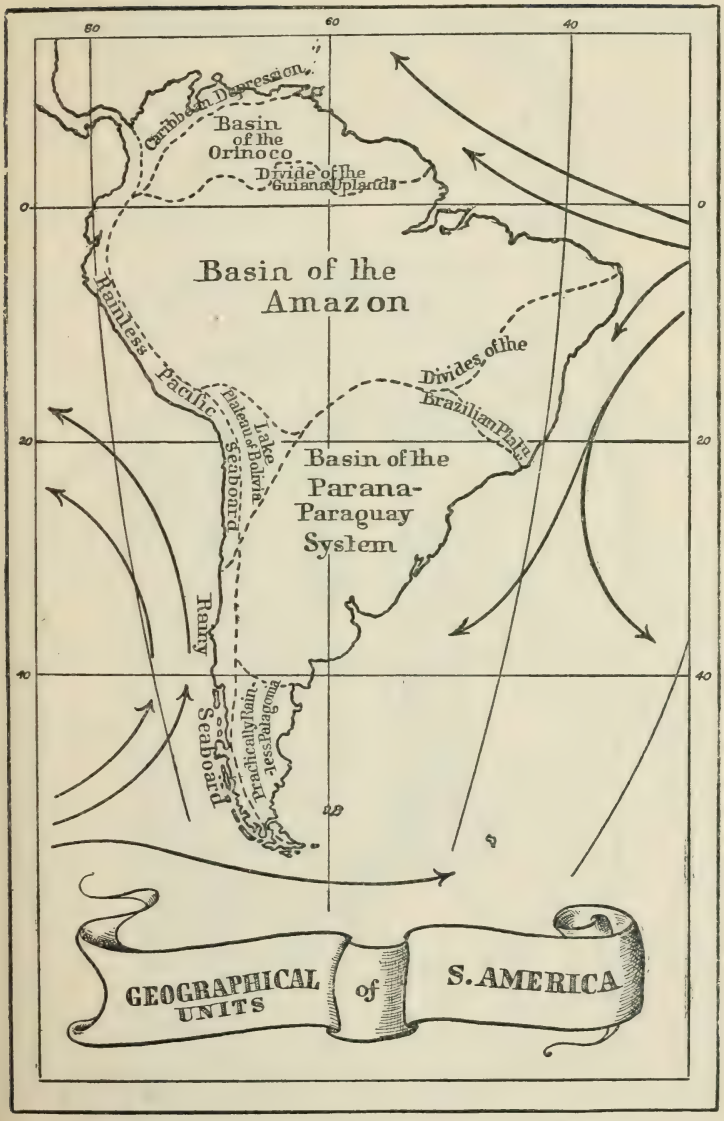


FIG 147.—GEOGRAPHICAL UNITS OF SOUTH AMERICA.

FIG. 148.—GEOGRAPHICAL UNITS OF AFRICA.

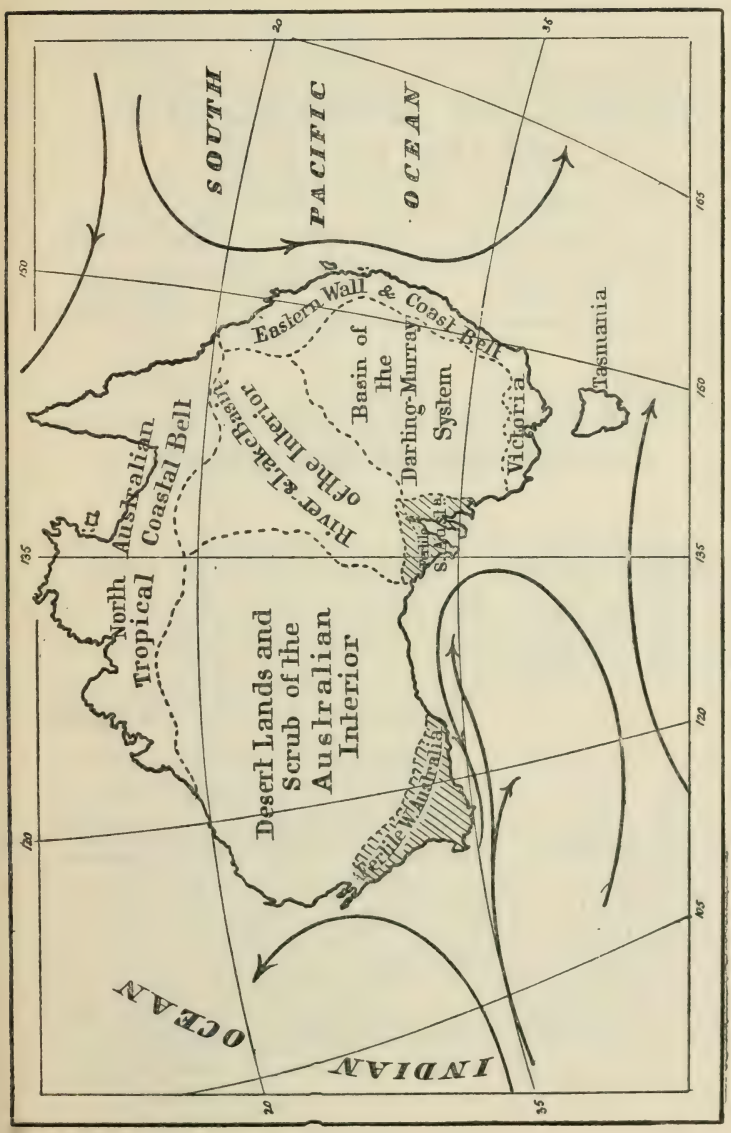


FIG. 149.—GEOGRAPHICAL UNITS OF AUSTRALIA.

Latitudes.	Equable.	Intermediate Types.	Extreme.
Warm Temperate.	The Atlas.	The Nile Delta.	
		The Abyssinian Tableland.	The Sahara.
	The Niger.		The Horn of Africa (Somali Peninsula).
	The Guinea Coast-lands.	Eastern Soudan.	
Tropic.		Central African Lake Plateau.	The Ngami Salt Basin and Kalahari Desert.
	The Congo.		
	Madagascar.	The Zambesi Tableland.	
Warm Temterate.		Cape Colony.	The Veldt.

Table of Geographical Units.—Africa.

Latitudes.	Equable.	Intermediate Types.		Extreme.*
Tropic.	The North Australian Shorelands.			
		Queensland Coastal Belt.		West Australian Interior.
		East Australian Coastal Belt.		
Temperate.		West Australian S.-W. Corner.	The Darling-Murray Basin.	The Lake Basin of South Australia.
	Tasmania.	Fertile South Australia.		
		North Island (N. Z.).		
		South Island (N. Z.).		

Table of Geographical Units.—Australia.

* Extremes are not so marked on the Southern Continent.

GEOGRAPHY OF THE BRITISH ISLES.

PART I.

CHAPTER I.

Relation of the British Isles to the Continent and to the Atlantic.

[Maps to be studied: North Atlantic; Europe: the Globe.]

The British Isles form an *archipelago* just off the western coast of Europe, which, though the smallest, is yet the most advanced of the continents in the civilisation of its peoples and the development of commerce.

World Position.—The British Islands lie at the centre of the Land-Hemisphere of the globe and on the north-eastern fringe of the Atlantic, which is the busiest of the oceans, owing to the fact that it divides Europe from the next most advanced and prosperous of the continents—North America.

Having an *average latitude of 55° N.*, the British Isles lie in that zone of the earth which yields the hardiest, most industrious and progressive races. Surrounded by *seas which never freeze*, seas which yield an *abundance of fish*; favoured with *numerous good harbours*, both toward America and

Europe; protected from invasion by the "Silver Streak" which divides them from the mainland; rich in *mineral resources*; peopled by a race inheriting *Teutonic* and *Celtic* qualities, they have taken first rank among the countries of the world.

Relation to the European Continent.—The British Islands are as essentially a physical part of the continent of Europe as are the Orkneys of Scotland or Anglesey of Wales. They stand on a *submarine platform*, which is merely a projection out to sea of the European continent. The higher parts of this projection, or submerged continental shelf, emerge as islands, and form the archipelago. The outer edge of this platform, or shelf, toward the abyss of the Atlantic, conforms very closely to the limits of the land groups of the British Isles. It may be taken as represented by the *100-fathom line*. At the *Straits of Dover*, the separation from the continent is at its minimum (21 miles), and the Channel is only 180 feet deep, which is considerably less than the depth of Windermere or Wastwater.

The *North Sea* is a shallow basin, deepening northward; the *English Channel* deepens westward, while the *Irish Sea* deepens southward, so that in every case there is a slope outward to the edge of the platform.

A *lowering* of the sea level to the extent of *one hundred fathoms*, or a corresponding elevation of the platform, would make England, Scotland and Ireland continental countries abutting on the Atlantic, with no outlying archipelago. The obvious result would be to convert existing plains to plateaux, and to increase the official altitudes of all mountains by six hundred feet. The seas of Britain would be replaced by river-basins.

A dominant river, draining northward along the basin left by the existing North Sea, would gather up the waters of the *east-flowing* rivers of Great Britain and the *west-flowing*

100-fathom line equals hypothetical Coast-line.
The 100-fathom line brings out the continuity of Norway, Scotland & the West of Ireland.
DEEP
ATLANTIC
OCEAN
100 fathom line
The shaded portion represents the submerged portions of the Continental shelf. The British Isles emerge from this shelf.
D = Dogger Bank
The Shaded areas are the chief sea-fishing grounds of Europe.

FIG. 150.—MAP OF BRITISH ARCHIPELAGO ON CONTINENTAL SHELF. (The arrows indicate probable courses of the rivers. It may be, however, that they united to carve the deep groove of the Norwegian coast).

rivers of Europe from Ostend northwards (*e.g.*, Tweed, Ouse and Nen; Scheldt, Rhine and Elbe). Another river would carry off the waters of South Wales and the Bristol Channel streams, as well as those of South Ireland, to an estuary midway between Cork and Land's End. A smaller stream would take the waters of the Clyde, Eden, Bann and Boyne, and the streams of Lancashire and North Wales through the narrow trough floored by the basalt of the Giant's Causeway, to merge in the Atlantic a few miles north of Malin Head. The net result would thus be a few *dominant river highways* of continental type, corresponding in importance and in area of catchment-basin to the Danube, the Rhine, the Elbe or the St. Lawrence. Great ports for *Trans-Atlantic trade* might grow up at the outlets of the two streams, draining from the bed of the present Irish Sea, one to serve the *north* (*cf.* Glasgow), the other to serve the *south* (*cf.* Cork).

The nearest point to the American Continent would lie within *three days' journey* of St. John's, Newfoundland. The *fiords* of Norway, the *sea-lochs* of Scotland, and the so-called *bays* of the west of Ireland would be left as smiling valleys or gloomy glens. The mountains of Norway, the highlands of Scotland, and the wild moors of Donegal and Connaught would appear as detached members of a single system having a north-east and south-west trend. Cornwall and Devon find their counterpart in the ancient axis of the Brittany peninsula. East Anglia is but the western fringe of a shallow basin which includes Flanders, Holland, North Germany, and Denmark.

The student may discuss the effect of a union (or really a reunion) with the Continent on our national character, international relationships, commercial competition, the control of the sea, and home defence.

Communications with the Continent.—The eastern and southern coasts of Great Britain are dotted with ports and packet stations, trading and communicating daily with conti-

nental ports and stations in ferry-like manner. The smaller ports serve the passenger traffic, while the larger ports, having *inland resources* behind them, serve as the *outlets of trade*, in addition to serving passengers. Thus (*e.g.*) Newcastle and Sunderland form outlets for the industries of the Northumbrian coalfield. Hull does duty for the West Riding and the Vale of Trent; Leith and Granton are the gates of the Scottish Lowland industrial area.

Atlantic Harbours.—The ocean-facing ports are fewer, but never inferior in importance. Scotland has Glasgow; Ireland has Derry and Cork; England is served by Liverpool and Bristol. The great industrial development of the South Wales coalfield has raised Cardiff to the third place among the ports of the British Isles.

Ice-Free Ports.—It is a matter of supreme interest to British shipping and commercial welfare that our ports are never closed by ice. One has only to glance at a Mercator's map of the Atlantic to see that Hudson Bay (south point), Montreal and the Baltic enjoy equally favourable conditions of *latitude* with the British Isles, *but* for weeks and months in the year their harbours are closed by ice. The secret of our *open ports*, then, is not one of latitude. It is to be found in the general drift of the Atlantic oceanic waters. This drift is in favour of Western Europe rather than Eastern Canada. Moreover, it is no accident, but the outcome of a general law which is observable in the circulation of both Atlantic and Pacific waters. The simple diagram here given (Fig. 151) will illustrate this. Text-books of Physical Geography or Part I. of this volume will fully explain the underlying causes.

The warm surface waters of the Equatorial belt drift westward, *opposite* to the direction of the Earth's rotation, and then sweep round, clockwise in the northern hemisphere,

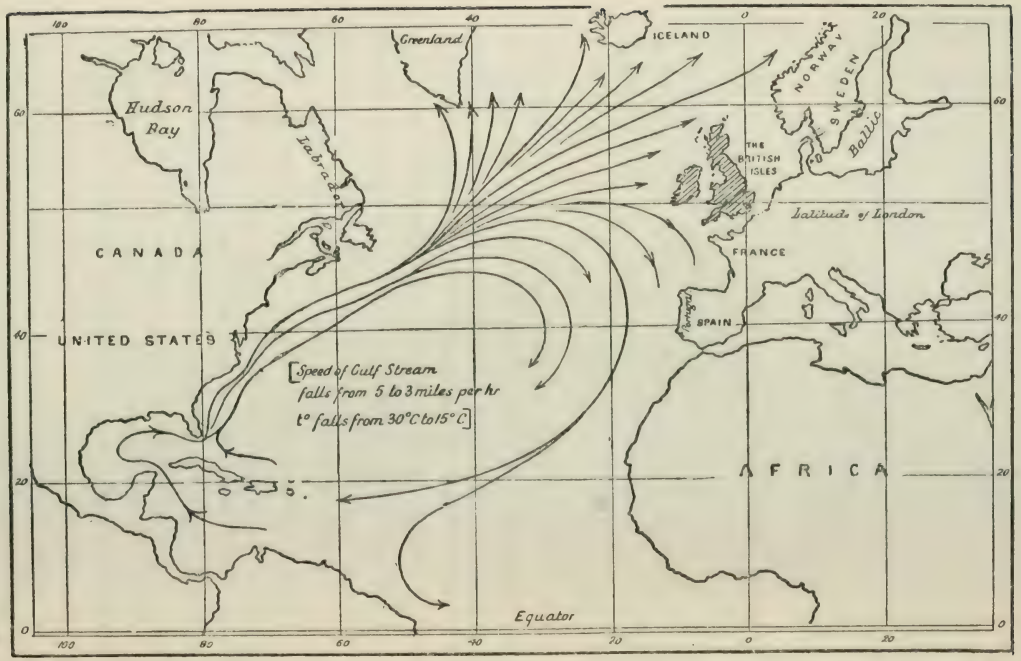


FIG. 151.— MAP SHOWING THE RELATION OF THE BRITISH ISLES TO THE ATLANTIC OCEAN.

counter-clockwise in the southern hemisphere, until they dispread and dissipate, fan-wise, in the general surface waters of the *temperate zone* regions, toward which they have been driven. It will be seen from the diagram that *Eastern Canada* is unbenefited by any such warm drift, for the circulation is *away from* her Atlantic shores, whereas the *British Isles* lie *in the track* of the out-spreading warm drift of the North Atlantic. The map of ocean currents reveals a cold Arctic drift inspetting along the coast of Labrador, which increases the rigour of the Canadian winter along the eastern sea board. Exactly analagous causes explain why Vladivostok is closed by ice for several months in the year, whilst Vancouver enjoys a genial climate.

CHAPTER II.

Broad Outlines of the Geological Structure of the British Isles.

[Map to be studied: Geological Map of the British Isles.]

It has often been remarked that the British Isles offer an *epitome* of the world's geology. No important geological formation is unrepresented in the British series of strata. There are rocks exposed in the British Isles as old as any exposed portion of the Earth's crust; there occur gravels, sands and glacial débris representing the most recent geological periods; and between these are sandwiched a continuous series of strata practically covering the whole period of geological history. As a result, our islands offer a variety of scenery, of resources both agricultural and mineral, and of industries springing therefrom not to be surpassed by any country.

OUTLINES OF GEOLOGICAL STRUCTURE.—For our purpose, the whole series of strata may be divided up most conveniently into four sections, as follows:—

3	Tertiary and Recent	3
2	Secondary (or Middle Aged)... ...	2
1*b*	Younger } Primary	1*b*
1*a*	Older } (or Ancient)	1*a*

The biologist, referring to the fossil remains of life-forms found in the rocks, uses roughly corresponding terms.

3 Caino-zoic.

2 Meso-zoic.

1*b* } Paleo-zoic { Deuto-zoic. (Gr. *deuteros*=second.)
1*a* } Paleo-zoic { Proto-zoic. (Gr. *protos*=first.)

Paleo-zoic (Gr. *palaios* = ancient, *zoe* = life) rocks, the earliest formed sediments, contain ancient and mostly extinct life-forms. Meso-zoic (*mesos*=middle) rocks belong to the middle life-period; Caino-zoic (*kainos*=recent) abound in more recent life-forms.

If the strata were everywhere horizontal, it is clear that only the Tertiary and recent rocks would appear at the surface; Secondary, or Mesozoic, rocks would lie concealed below; Primary, or Paleozoic, rocks would only be reached by deep borings or in deep ravines. Such an exposure is

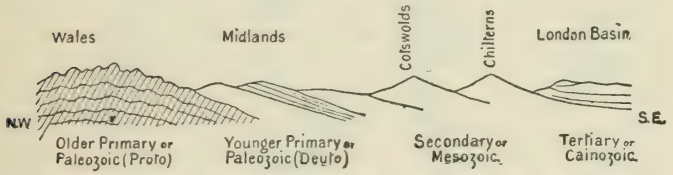


FIG. 152.—SECTION ACROSS ENGLAND AND WALES, NW.-SE.

actually seen in the Grand Canyon of Colorado. But if, by any forces of nature, strata have been tilted or folded, the possibility arises of Primary and Secondary rocks appearing at the surface, and contributing to the character of the scenery and the soil, as well as giving access to new mineral resources. And such is the case. Tilting and folding of strata are the rule, and not the exception, with the result that the British Isles offer the variety of scenery, resource and industry to which we have referred.

Figs. 152 and 156-159 serve to show how a diversity of surface may arise when a series of varying strata is exposed

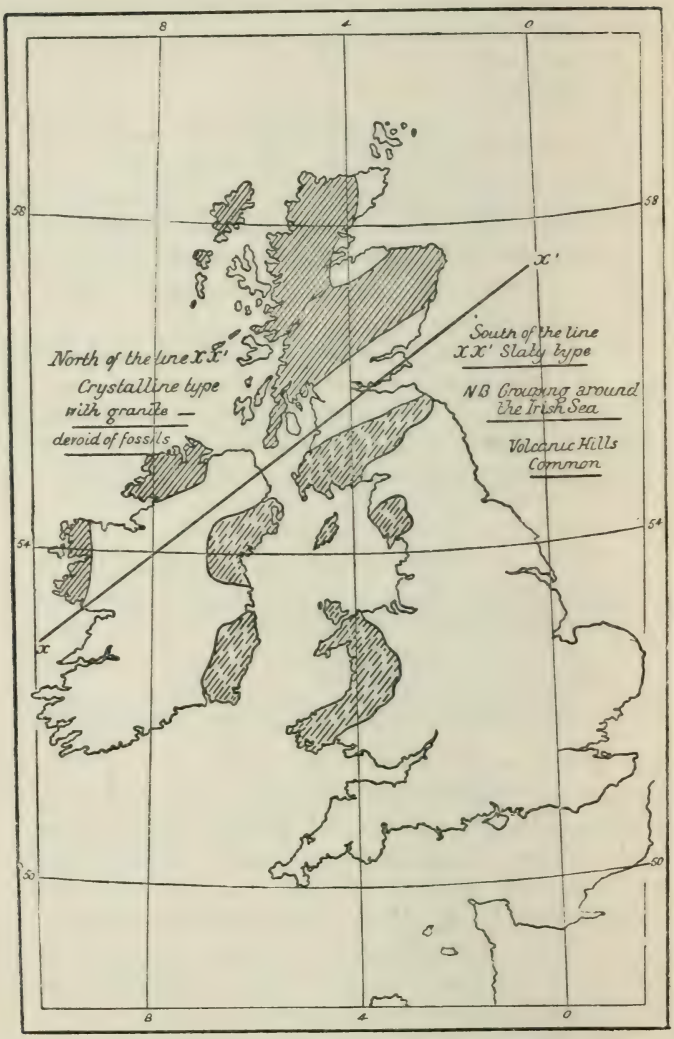


FIG. 153.—MAP OF OLDER PRIMARY ROCKS.

* The crystallines are older than the slates.

to the sculpturing action of rain and frost. The general arrangement of the British series of strata in England, where exists a greater variety of rocks than in Scotland or Ireland, is simplified somewhat in Fig. 152.

Primary Rocks.—The older primary rocks, being very ancient, are much altered from their original condition as sediments. They are usually compact, grained in structure, difficult to quarry, rich in mineral veins, but poor in limestones (since shell organisms were rare). They are always folded and crumpled, and therefore exposed, especially in mountain regions. Granite and slate are quarried, lead, copper, tin and a little silver have been worked in these ancient rocks. They are well exposed in North and West Wales, Cumberland, the Southern Uplands of Scotland, the Grampians and Northern Highlands, the Mourne Mountains, Wicklow, Donegal and Connaught. The crystalline rocks are devoid of fossils.

The younger primary rocks include the *Old and New Red Sandstones*, with the *Coal Measures* between. It is seldom, however, that all three series are to be found in the same district. The Old Red Sandstone occurs in the counties of the Welsh border, and again in Munster, the south-west corner of Ireland. It is best represented in Scotland, where it floors the Lowland trough (see Fig. 161), and emerges in a long, broad outcrop on the northern edge, forming the fertile vale of Strathmore, and terminating in the red cliffs of Stonehaven. The lowlands around the Moray Firth form another Old Red Sandstone basin, and the volcanic hills of the Cheviots are flanked by still another outcrop of the same sandstone.

The **Coal Measures** vary greatly in different districts, but may be taken, for the purposes of physical geography, to consist of

(*c*) Coal Measures proper.
(*b*) Grit.
(*a*) Limestone.

The *Limestone* is well exposed in the Mendips, the Peak

FIG. 154.—MAP OF YOUNGER PRIMARY ROCKS.

District and around Ingleboro', in the Pennines. Lead veins are common in the mountain limestone wherever volcanic rocks have been intruded. It forms the central plain of Ireland. The *Grit* is best developed in the Pennine Moors, between the two coalfields of Lancashire and Yorkshire, and on the South Wales coalfield. The Coal Measures are sandstone flags and fire-clays, with bands of coal. Their general arrangement is more simple than might at first appear. In Scotland they lie in the S.W.-N.E. Lowland depression. In Ireland they occur in scattered remnants over the limestone plain. In England and Wales they may be grouped into two series :—(*a*) Following the base of the Pennine uplift; (*b*) Forming a ring around the Welsh border. Fig. 154 will bring out this general arrangement. In many parts of England the Coal Measures lie partially concealed below the New Red Sandstone, appearing at the surface only when exposed by denudation of gentle folds in the basin. Examples of this are seen in the Midland coalfields. The vale of Eden, the plain of Lancashire and Cheshire, the vale of York, the basins of the Trent and Severn, and the flats of Somersetshire are New Red Sandstone areas. The close parallelism of arrangement between the detached coalfields and the continuous red sandstone plains is worthy of passing notice. New Red Sandstone as a geographical feature is negligible in Scotland and Ireland, excepting the flat country around Dumfries, which is part of the Eden formation.

Secondary Rocks.—The upper portion of the New Red Sandstone introduces the Mesozoic or Secondary type, which is chiefly represented by plains of clay and ridges of limestone sculptured out of gently tilted strata of variable resisting powers. They extend in two fairly persistent ridges across England in a north-east—south-west direction, from Cleveland and Flamborough to Portland and the Isle of Wight.

The older ridge to the west is built of the fairly hard limestone known as freestone, roe-stone, or oolite (Gr. *oon*=egg,

FIG. 155.—MAP OF THE SECONDARY RIDGES.

lithos=a stone). The freestone is eminently suitable for building, being easily quarried and chiselled into graceful form, and at the same time hardening rather than crumbling on exposure to the weather. Ironstone bands are common.

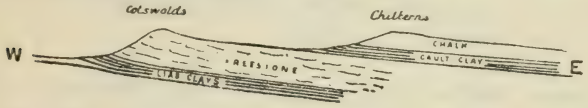


FIG. 156.—SECTION ACROSS THE MESOZOIC RIDGES.

The younger and eastern ridge is the well-known English chalk, which terminates in the white cliffs of Flamborough, The Needles, Beachy Head, and the Forelands of Dover and Thanet.

FIG. 157.—SECTION ACROSS THE CHALK RIDGES OF THE SOUTH-EAST OF ENGLAND.

Figs. 156 and 157 show the general arrangement of the ridges, and illustrate the relation of the secondary rocks to one another.

In the south-east of England the Secondary rocks have been thrown into folds, giving the troughs known as the

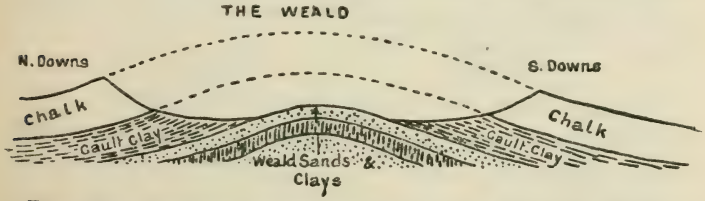


FIG. 158.—SECTION ACROSS THE WEALD (ON LARGER SCALE).

London and Hampshire basins respectively, separated by the axial uplift of the Weald of Sussex and Kent. The troughs

have been infilled by sands and clays of Tertiary age, whilst the uplift has been eroded so as to expose the Gault clay and other strata older than the chalk that was once continuous over them. Such erosion has given rise to the escarpments of the North and South Downs, facing each other and overlooking the Weald (or woodland).

Tertiary Rocks.—The London and Hampshire basins hold the bulk of our British strata of Tertiary age. These strata are chiefly stiff clays (*e.g.*, the London Clay) with loose sands and gravels. In the Hampshire basin clays are not so prominent, and soft friable limestones occur. Building stones and

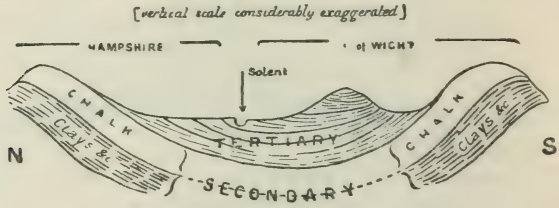


FIG. 159.—SECTION ACROSS THE HAMPSHIRE BASIN.

mineral ores are unrepresented, if we except the Bembridge limestone of the Isle of Wight. Even younger than the beds of these basins are the shell gravels of the Norfolk and Suffolk coasts.

Glacial Débris and Alluvial Lands.—Covering the plains and valleys of England, as far south as the Thames, is a mantle of glacial deposits. These were left by the retreat of ice-sheets at the close of the Ice Age. They are characterized by irregularity of bedding, the débris lying simply on the sculptured surface of the pre-existing strata. The deposits also vary in composition according to the character of the rocks traversed and eroded by the ice-sheet in its southward creep.

FIG. 160.—MAP OF TERTIARY (*shaded*) AND RECENT (*dotted*) AREAS.

The flats of Holderness and the Fens around the Wash represent the most recent land surfaces.

Secondary and *Tertiary* rocks are but poorly represented in Scotland and Ireland. The plateau of Antrim and some of the islands of the chain of Inner Hebrides are built of them, but volcanic rocks predominate, whereas in the London and Hampshire basins they are entirely absent.

Scotland is mainly built of *Primary* rocks forming the wild Highlands and the southern uplands, the younger primary rocks filling the Lowlands with a trough of Old Red Sandstone carrying the Scottish coalfields.

Fig. 161.—Section across Scotland, N.W.-S.E.

Ireland is essentially a trough of ancient limestone, whose four upland corners are—

1. Donegal Mountains and Connaught—a continuation of the Scottish Highlands.
2. Mourne Mountains—corresponding to the southern uplands.
3. Wicklow Mountains—the equivalents of North Wales.
4. The ridges of Munster—recalling the structure of St. David's peninsula.

It is reserved for another chapter to discuss the resemblances of scenery, resource and industry arising out of similar geological areas subjected to like conditions of temperature and rainfall.

Geological Relation to the Continent.—A geological map of the continent brings out very clearly the former union of our islands with the mainland. Brittany is seen to be the paleozoic counterpart of the Cornish peninsula. Normandy forms a link

FIG. 162.—MAP OF GEOLOGICAL RELATION TO EUROPE.

in the chain of Secondary strata connecting Portland and St. Alban's Head with the Juras. The Paris Basin shows striking geological resemblances to the Hampshire area, and Flanders corresponds geologically to the Thames Valley. The English Fens find their equivalent in the Polders of Holland. The Scottish Highlands follow the trend of the Norwegian Axis.

CHAPTER III.

Relation of Geology to Scenery in the British Isles.

[Maps to be used: Geological and Physical (Orographical) Maps of the British Isles.]

The varied geological structure of our islands is the prime cause of the diversity of scenery offered. Hard rock and soft materials have been exposed for ages to the sculpturing action of rain and frost, sun and wind. Denudation has been followed by transport of materials to lower levels. Earth sculpture has been modified by tillage and agricultural development. The sea, too, has been at work along our coasts, leaching out the soft materials and leaving the hard resistant rocks to stand out as headlands, stacks and rocky islands. The gradual subsidence of the continental shelf has allowed the sea to creep far into the valleys of the western borders, forming fiord-like sea-lochs, loughs and bays, and converting mountain groups into off-lying archipelagos.

The tidal wave carries the sea so far up these valleys that probably no place in our islands is more than fifty miles from a navigable river.

Scenery of the Primary Rocks.—The older primary rocks of the Highlands, Grampians, Lake District, Wicklows and

North Wales, as well as distant Connemara and Donegal present the wildest and most majestic scenery. Cloud-begirt moorlands and rocky fells—subject to heavy rains and scoured by mountain torrents, with deep lakes or mountain tarns in beds of impervious slate or crystalline schist—they are fine in summer, but dreary and unvisited in the winter. The wildest scenery is associated with the abundant remains of volcanic material left by the "Age of Volcanoes," which covered a considerable epoch of earlier paleozoic time. Snowdon and Cader Idris, Helvellyn and Scawfell are remnants of volcanic piles.

Of the younger primary rocks, the Old and New Red Sandstones occur in basins and troughs, forming fertile plains such as Strathmore, the vale of York, the plain of Lancashire and Cheshire, the basin of the Trent and the vale of Taunton. The limestone equivalent of the Cornish peninsula gives beautiful coast scenery, wild where slates or granites replace the limestone. The foundation—*Limestone*—of the coal series gives the fine scenery and caves of the Peak district, and again of Cheddar in the Mendips. It forms the rim of the South Wales coalfield and the Forest of Dean, and gives rise to the lovely scenery of Tintern and the winding Wye. The *Grit* of the same series attains its maximum thickness in the lonely moors of Yorkshire and Lancashire. The coalfields themselves are comparatively flat and lacking in scenery.

Secondary and Tertiary Rocks.—The Oolite or Freestone ridges present their steep escarpments to the west and overlook the plain of the Lias clays and New Red Sandstone. They descend in gradual terraces to the clay-plains and fertile meadows overlooked by the parallel rounded ridges of the English chalk downs and wolds. The soft chalk downs, treeless, and covered with yellowish green turf, support thousands of sheep.

The Tertiary basins afford some of the most pleasing of our

English landscapes, rich in corn and pasture, woodland and fruitful orchard.

The gravels of the numerous heaths which rest upon the London clay and its Hampshire equivalent are famous for their pine-woods.

Coast Scenery.—Our British coasts, too, offer an endless variety of scene. Here again the wildest and most majestic scenes are to be found among the cliffs of folded Older-Paleozoic rocks of Cornwall, Anglesey, Donegal, the Isle of Man and the Western Highlands and islands of Scotland. The Old Red Sandstone gives fine coast sections in the bays of Kerry, the stacks of Orkney and the wall-like cliffs of Stonehaven.

The volcanic rocks of the Lowland basin of Scotland not only give rise to two series of hills—the Pentlands and Lammermuirs, the Ochils and Sidlaws—but also to a chain of islands in the Firth of Forth.

The great Whin Sill of the Northumberland coalfield breaks out on the coast in Bamborough Castle Rock and the Farne Islands.

The fine cliffs of the Durham coast mark the northern termination of the Magnesian Limestone which, *east* of the Pennines, roughly takes the place of the middle part of the New Red Sandstone. It is an *intrusive* volcanic sheet.

The banded Secondary strata of the Cleveland and North York Moors give the fine cliffs between Whitby and Filey.

Flamborough Head is the northern extremity of the chalk, which runs out to Dover cliff, the Forelands, Beachy Head, and the Needles in the south. St. Alban's Head and the Isle of Portland are the southern extremities of the Oolite ridge.

Land's End is a granite promontory. Lundy Island is an old volcanic remnant. The Gower peninsula is a westward extension of the fold in the South Wales coalfield.

St. David's Head and Anglesey are fragments of crumpled rock of earlier Paleozoic age. St. Bees' Head is a mass of New Red Sandstone. The Mull of Cantyre is an ancient mountain range jutting far out into the sea. The Giant's Causeway and several of the islands of the *Inner* Hebrides are relics of a great outpouring of lava in Tertiary times. The plateau of Antrim is seen to be a plateau of Secondary rocks preserved from denudation by a cap of basalt, which up-welled and covered the plateau in the Tertiary epoch.

Nowhere in an equal area can so much variety of geology and scenery, such resource of minerals, such skill in agriculture be found as in the British Isles.

CHAPTER IV.

Temperature and Rainfall over the British Isles—Effect on Agriculture.

[Maps to be studied: Isothermal Maps for July and January; Rainfall Map.]

If the Earth were an airless, waterless globe, having a homogeneous crust and an erect axis, the belts of latitude would correspond with belts of temperature. All places on a given line of latitude could be expected to have the same average temperature.

In mathematical language, a line of latitude is the locus of all places equidistant (north or south) of the Equator (0° Lat.). In the same way an isothermal is the locus of all places having the same average temperature (*i.e.*, equidistant thermally from 0°C or 0°F according to scale employed). In the above case lines of latitude and isothermals would coincide. Belts of latitude would represent belts of temperature But observation proves that such is far from the actual facts. Air circulation, water distribution, variety of rock-constituent and an inclined axis all are factors in producing diversity of climate.

Types of Climate.—In July there are places within a few degrees of the Arctic Circle and others only a few degrees outside the Tropics enjoying the same average temperature as Liverpool or Dublin (*e.g.*, the coast of California and the

north-east corner of Siberia). The isothermal connecting these places varies widely from any line of latitude.

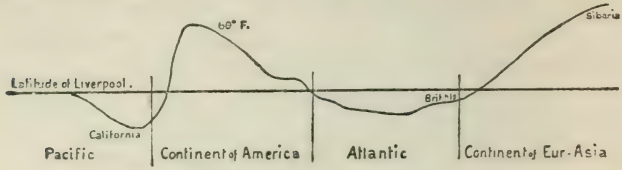


FIG. 163.—AN ISOTHERM.

A study of the isothermal maps of the world on Mercator's projection reveals clearly that temperature zones do not coincide with latitude zones. The variation is greater in the Northern Hemisphere, where land masses alternate with ocean basins. The variation depends on the distribution of land and water. The physiographical discussion of this subject will be found in Part I. of this volume. Suffice it to say that the belts of temperature bend northwards over the land masses, and southwards over the oceans in the Northern Hemisphere during July.

The map for January shows an opposite variation in the isothermal lines, and their enclosed temperature belts—southward-bends over the land masses, northward-bends over ocean basins.

FIG. 164.—JULY TEMPERATURE BELT.

From the two maps (Figs. 164 and 165) we see that the British Isles are as cool as Finland or the great North-West

of Canada in July, and as warm as Asia Minor or the middle states of America in January. British weather is, therefore, neither intensely hot in summer nor intensely cold in winter.

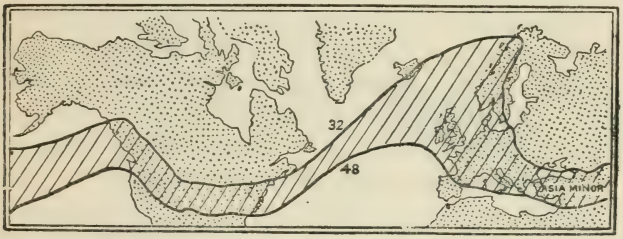


FIG. 165.—JANUARY TEMPERATURE BELT.

If we compare the prairies of Canada and the wheat lands of Siberia—both in the *same latitude* as England, and both continental interiors—we find they are considerably hotter in summer and colder in winter.

This diagram brings out the difference between a climate of extremes, such as is experienced in the continental interiors,

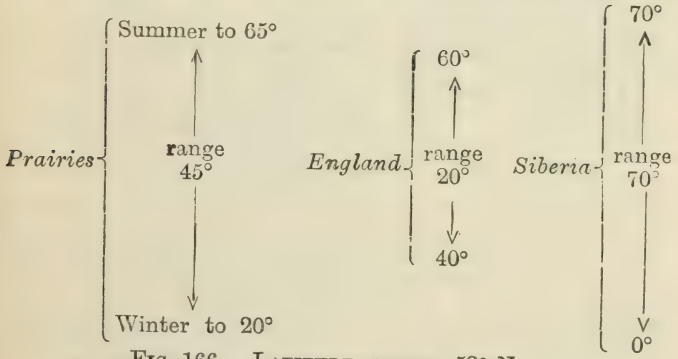


FIG. 166.—LATITUDE CHOSEN 52° N.

and a fairly equable climate, such as is enjoyed by the British Isles. The former is often called a continental climate, and the latter approaches an insular climate.*

* The *range* in the Island of Samoa, where Robert Louis Stevenson lived, is 5° or less (80°-75°).

The causes which combine to favour the British Isles in the matter of temperature are many and complex. Besides the arrangement of the land masses, there needs to be taken into account the warm oceanic surface-drift, the influence of warm winds from the south-west, and especially the effect of rainfall. Heavy rainfall and equable climate usually go together. Scant rainfall and excessive temperatures (high and low) are similarly connected. It is interesting to compare a map of temperature belts with a map of rainfalls. Heavy

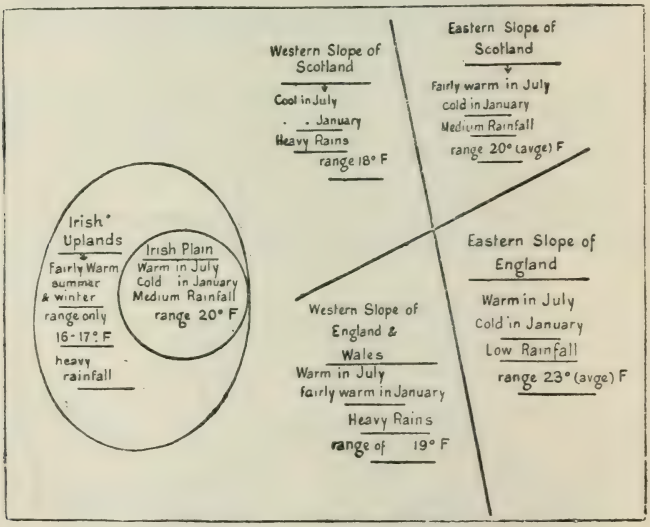


FIG. 167.—BRITISH CLIMATE.

rains and equable climate give great fertility, whereas extremes of temperature and lack of rain yield only barren desert.

In the wet areas themselves the rainfall attains its maximum in the highest mountain groups—Killarney, Connemara, Dartmoor, the Cader group, Helvellyn and Ben Nevis. Again, in the drier east, the rainfall is greater on the hills than on the plains. It is clear that mountains are connected

in some way with increased condensation. The rain-bearing winds are deflected upward into the colder layers of the atmosphere, and condensation results. We are now in a

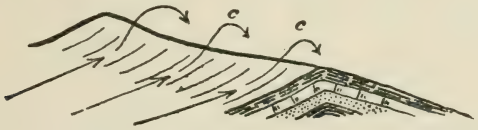


Fig. 168.—Mountains affecting Rainfall.

position to summarise, in two diagrams, the chief facts of British climate. (*See* Fig. 167.)

Agriculture.—This variation of climate over countries so varied in geological structure must have its effect on the agriculture of our islands.

Broadly speaking, agricultural industry may be divided into (*a*) the growing of cereals, (*b*) the cultivation of green crops, (*c*) the rearing of cattle and dairy-farming, and (*d*) sheep-farming.

Sheep can subsist on poorer grass lands than those required for the rearing of cattle and the yielding of dairy produce. The moorlands and hill pastures of rainy regions support sheep. The fertile and less rainy lowlands, usually sandstone basins or alluvial flats, afford our corn and vegetable supplies, whilst the less fertile, stiff clays and glacial till, are dotted with stock and dairy farms. The Chalk Downs, retaining so little of the rain which falls upon them, yield a poorer quality of grass—yellowish-green, and more suitable for sheep than for dairy farms.

The close inter-relation of elevation, temperature, rainfall and agriculture will be brought home to the student if he fills in from the maps studied the details necessary to complete the table on page 210.

	Unit Districts.	Average Elevation.	Average Summer t°	Average Winter t°	Range t°	Rainfall.	Nature of Soil.	Crops—Corn or Vegetables.	Stock—Sheep or Cattle.	Density of Population.
Scotland.	Highlands...									
	Grampians..									
	Eastern Shelf									
	Lowlands ...									
	South Uplands									
England and Wales.	Pennines ...									
	Ouse and Trent.....									
	Cleveland Wold									
	Lake Dist.									
	Lancs. and Cheshire..									
	Wales.....									
	S. Midlands									
	E. Anglia...									
	Bristol Chnl.									
	Cornish Peninsula									
	Lond. Basin									
	S.-E. Eng...									
Ireland.	Ulster.....									
	N.-W. Rim									
	Central Plain									
	S.-W. Rim (Munster.									
	S.-E. Corner									

CHAPTER V.

The River-Systems of the British Isles.

In the larger island of Great Britain the natural drainage is comparatively simple. We have a main "divide" running lengthwise through the island, cutting off the rivers draining westward to the Atlantic, from those draining eastward to the North Sea. The outstanding masses of the Cumbrian and Cambrian groups send out radiate systems of streams, all of which eventually open into the western seas. Two transverse axes lead to minor streams flowing north and south, instead of east and west. Those flowing north form tributaries of larger east—west streams. Those flowing south empty themselves directly into the Channel (*c. d.*) or Solway Firth (*e. f.*).

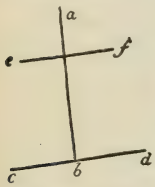


FIG. 169.—AXES OF DRAINAGE.

The transverse divide of the south of England coincides with the axes of the Mendips and the Weald. That of the Southern Uplands of Scotland divides the tributaries of the Tweed from the streams which follow parallel courses to the Solway.

Fig. 170 groups the rivers on the two bases of common origin and physically similar drainage-area.

Rivers of Scotland.—The *rivers of the Moray basin* rise in the Highlands and Grampians (*e.g.*, Spey), and find their way across the Old Red Sandstone to the Moray Firth. Those

from the Highlands terminate in firths; those from the Grampians do not. This points to a subsidence on the northern side of the Great Glen.

The *rivers of the eastern slope* run out from parallel valleys in the Grampians across the flat coastal rim of east Scotland, and join the sea in pairs at Aberdeen and Montrose. The rivers of the Lowlands have parallel but opposite trends across two troughs on the Scottish coalfield. Their estuaries creep far up into the land where mine and soil are most productive (Clyde, Forth, and Tay). The Tweed again shows a parallelism with the submerged Solway, but an opposite trend. It receives many streams from the south, whilst the Solway receives as many from the north.

Rivers of England and Wales.—The *rivers of Northumbria* run in striking similarity of direction from the Pennine Uplands by way of the rich coalfield to a series of valuable estuaries (Blyth, Tyne, Wear, Tees). The *Ouse and Trent* gather up the streams of the south-east Pennine slopes, the Yorkshire and Midland coalfields, and the New Red Sandstone basins, and pour their mingled waters into the common outlet of the Humber. West of the Pennine Axis the *rivers of the Lake District* are mostly overflow streams from the ribbon-lakes which fill the valleys. The Eden drains rather from the Pennines, but receives the overflow of Ullswater a few miles below Penrith.

The parallel *rivers of the Lancashire Plain* reproduce the characteristics of the streams of the Yorkshire dales. The Weaver of the Cheshire plain corresponds to the Trent, and joins the Mersey in a common outlet.

The *rivers draining to the Wash* take parallel courses between the oolite ridge and the chalk escarpment. A very faint divide separates their head-waters from the streams which converge to make the Thames.

The *Thames* escapes through a gap which it has cut for

FIG. 170.—RIVER SYSTEMS OF THE BRITISH ISLES.

itself in the Chiltern Hills at Wallingford, and gathers up the streams of the London basin on its easterly course to the busiest estuary in the world. The number of streams which break through gaps in the chalk from the south on their way to join the Thames is indeed remarkable. The Wey, the Mole, the Darent, and the Medway are excellent examples. A corresponding series breaks through the South Downs to join the English Channel (Ouse, Arun). The unimportant *Frome* is the Hampshire basin equivalent of the Thames. Perhaps the Solent and the channel of Spithead represent its eastward continuation, and the narrow channel at Hurst Point—the westward gate of the Solent—may recall a gap in the chalk. (*See* Fig. 196.)

The *Severn and other Welsh streams* flowing to the Bristol Channel exhibit a curious parallel arrangement one to another, and all to the border dividing Welsh upland from English lowland. Just as the Kennet appears to be the axial stream of the London basin, so the Stratford Avon is related to the depression of the Bristol Channel. The *streams of Dartmoor* recall the streams of the Lake Group, but are devoid of lakes.

Rivers of Ireland.—In the sister island the drainage systems are not so simple. *Rivers of the Severn type*, finding their way round the base of a mountain group to join the sea at a point where the mountain-rim of the country is broken, are common (*e.g.*, the Shannon, the Liffey, the Slaney).

The parallel *rivers of Munster* draining eastward, as well as the bays opening westward, point to a regular system of folds of the sandstone in that region. Here again gaps are noticeable. The streams escape at right angles to their upper courses and join the sea. The lakes of the Shannon and Erne, as well as Lough Neagh, are merely permanent expansions of the stream in leached-out limestone basins.

The Gateways of Trade.—Our islands are rich in harbours offering safe anchorage for ships. These are usually in tidal

river-mouths, and form the gateways of inland basins, which yield the exports and call for the imports that together determine the prosperity of shipping and commerce. The Moray basin has *Inverness*; the eastern slope uses *Aberdeen* and the ports of the Tay.

The Lowlands are almost bisected by the *Clyde* and the *Forth*. Northumbria has the deep-water tidal rivers of the *Tyne*, the *Wear*, and the *Tees*. The *Humber* serves the *Ouse* and the *Trent*. The *Thames estuary* is the outlet of the London basin. *Spithead*, the *Solent*, and *Southampton Water* are the gates of the Hampshire basin. The *Bristol Channel* is the water-highway for the trade of the South Wales and Somersetshire coalfields, as well as the nearest outlet westward for the southern half of the Midland plain. The *Mersey* serves Lancashire and competes with the Bristol Channel for ocean traffic with the towns of the Midlands.

Lough Foyle and *Belfast Lough* in the north of Ireland, *Dublin Bay*, *Wexford* and *Waterford Harbours* on the east, the magnificent harbour of Queenstown and the estuary of the Shannon, provide Ireland with harbours which deserve a greater trade than the resources and state of development of her hinterland permit.

CHAPTER VI.

Distribution of Mineral Wealth in the British Isles, and its Relation to British Industry.

[Maps to be studied: Geological and Industrial Maps* of the British Isles.]

THE mineral wealth of our islands is practically all associated with the Primary (or Paleozoic) rocks. The New Red Sandstone contains salt and gypsum. The older ridges of the Secondary (or Mesozoic) rocks yield a few ironstones (Cleveland, Lincolnshire, Northamptonshire, and Wiltshire), some good building stones (Bath and Portland), and excellent cement-layers (Warwickshire). The Chalk yields very pure limestone, easily convertible into lime; whiting is also made. The Tertiary (or Cainozoic) basins are devoid of mineral resources except in very restricted localities (Bembridge stone, I. of W.).

Ireland and the Highlands are exceptionally poor in mineral resources.

Coal and *Ironstone* abound together on our numerous coalfields. *Lead* and *Tin* ores are profitably worked in the rocks older than the coal. The former is usually associated with the ancient limestones; the latter is closely connected with the igneous rocks of the Cornish peninsula. *Copper* and *Silver* ores are scarce. *Gold* is present in such small quantities as not to be worth the working (Wicklow and Wales).

* Messrs. Bacon publish excellent 1d. industrial maps.

Apart from the lead mines of the Pennine limestone regions (Cumberland, Derbyshire), the tin mines of Cornwall, and the ironstones of the Oolitic ridge above mentioned, it is to the great coalfields we must look for the mineral wealth which is the material secret of our industrial prosperity.

Coalfields.—The arrangement of the *English* coalfields around the bases of the ancient uplands of the Pennines, the Lake District, and Wales has already been illustrated in Fig. 154, Chapter II. The Yorkshire coalfield has been cut off from the Northumbrian coalfield by gentle east—west upfolding and subsequent denudation. Another more striking fold—the anticline of the Pennines—separates it from the Lancashire coalfield. It is interesting to note the co-extensive stretch in latitude of the two sets of coalfields on the two sides of the Southern Pennines. Reference has also been made to the ring of Welsh border coalfields. They exhibit a striking parallelism to the course of the Severn. The small coalfields of the Midlands appear to be southern detached extensions of those on the Pennine flanks. They emerge from below the New Red Sandstone in areas where it has undergone denudation consequent on folding.

The *Scotch* coalfields lie in close contiguity on the Lowland Plain.

The *Irish* coalfields are mere vestiges scattered over the limestone interior. The lack of coal has hindered the industrial development of Ireland.

Iron Industry.—The coalfields which are especially rich in *iron-works* are those which have in their immediate vicinity beds of limestone. The limestone is quarried and converted into lime, which serves as a flux in the smelting process. The ironworks of the Oolite ridges (Middlesborough, Gainsborough, Wellingborough, and Westbury, Wilts) are all within easy access of coalfields.

Building Stones, etc.—Excellent building stones are quarried in the Primary and Secondary rocks. The *granites* of Aberdeen and Shap Fell (Westmoreland) are most famous. Those of Dartmoor, Charnwood Forest (Mount Sorrel, Leicestershire), and the Mourne Mountains of Ireland, make excellent road-metal. The *diorites* of the Channel Islands and the *Whin Sill* of Northumbria serve a similar purpose. Like the granites they are of igneous origin. The almost pure white *kaolin* (china clay), derived from the atmospheric degradation of granite, is obtained in many of the hollows of Dartmoor, especially in the Tamar Valley and at Bovey Tracey.

The *slates* of North Wales and Cumberland belong to the older Primary folded rocks of clayey origin. The younger Primary rocks yield the *hard grits* of the Pennines (used for building and for millstones) and the *magnesian limestone* which runs along the eastern flanks of the Pennines from Nottingham, *viâ* Pontefract, to the famous cliffs of Marsden, on the Durham coast. The *freestone* of Bath and Portland is one of the best building stones in Europe. The Houses of Parliament are built of magnesian limestone. St. Paul's Cathedral is built of Portland stone. Innumerable *chalk pits* and *lime-kilns* occur on the downs and wolds.

The *clays* of the fens and other alluvial grounds are used in brick-making. Many brick-works occur in the Thames Valley.

BRITISH INDUSTRIES.—An industrial map of the British Isles reveals the fact that the industrial areas lie on or near the coalfields. Other industrial centres are either ports or railway centres such as market towns in agricultural districts.

Scotland.—Outside the trough of the Scottish Lowland coalfields, we have:—

(*a*) The granite industry
(*b*) The whale and seal fisheries } of Aberdeen and its group of towns.
(*c*) The tweed-cloth manufacture carried on at Hawick, Galashiels and Peebles in the upper valley of the Tweed.
(*d*) The slate quarries of Ballachulish (close to Glencoe).

Dundee and the Tay ports lie just over in the next valley from the coal, but easy of access. They are engaged in linen, jute, rope and sailcloth trades, as well as providing whalers and trawlers for deep-sea fisheries.

The *Forth estuary* is bordered north and south by coal-fields, on which ironworks (Falkirk), breweries (Alloa) and table-linen factories (Dunfermline) have grown up. The *Clyde* is the outlet of the busiest area in Scotland. Glasgow is the focus of industry. The shipyards of the Clyde and the linen-thread of Paisley have a world-wide fame. Oil shales yield considerable supplies of paraffin. The *Ayrshire coalfield* supports Kilmarnock's woollen industry, and exports its surplus coal (largely to Ulster) from Ardrossan. Edinburgh and its port of Leith stand in close proximity to the Lowland coalfield.

England and Wales.—Carlisle and Berwick are the gates of entry by rail or road from England to Scotland. Their railway works are within access of the Cumberland and Northumberland coastal coalfields.

The *Cumberland*, or *Whitehaven*, coalfield is chiefly busy exporting its coal. Barrow-in-Furness and Belfast are within easy reach.

The *Northumbrian* coalfield serves the shipyards, engineering shops, ordnance factories and alkali works of Tyne and Wear. An immense surplus of coal is shipped to London, Hamburg and continental ports. Ironworks abound in the county of Durham (Consett, Seaton Carew, Jarrow). Much ore is imported from Sweden and Spain. The lower valley of the Tees, lying midway between the coal of Durham county and the iron-ore of Cleveland, has developed into a centre of the iron and steel trades. Darlington and Middlesborough represent the two counties of Durham and Yorkshire. Stockton and West Hartlepool stand on the Durham side of the estuary. Salt occurs in the Tees Red Sandstone.

The *Yorkshire* coalfield includes the great woollen industry, which centres in Leeds, and the famous cutlery industry associated with Sheffield. Leeds has many forges and machine works, as well as a large trade in clothing. Bradford is famous for light dress fabrics, whilst Huddersfield weaves heavy woollens. Halifax, Dewsbury and Wakefield share the industry of the area. Sheffield is surrounded by Rotherham, Wath, Penistone and Clay Cross, all busy in the iron and steel as well as the coal-distributing trade.

The *Lancashire* coalfield is divided into northern and southern districts by a transverse ridge of moorland. Manchester, and the group of towns to which it serves as a great emporium, form the seat of the great cotton industry, the products of which make the staple export of our islands The second series of towns—Rochdale, Blackburn, Wigan, and Preston—share in the cotton trade, and add the manufacture of blankets. Chemical and soap works have sprung up along the Mersey and the line of the Manchester Ship Canal.

The southward extension of the Yorkshire coalfield serves the mills of Nottingham and Derby. The former makes cotton hosiery and lace curtains; the latter is engaged in building locomotives and railway rolling-stock (M.R.).

The southward prolongation of the Lancashire coalfield is the home of the Potteries, with Burslem and its group of towns (Hanley, Stoke, Longton, etc.).

The *Midland* coalfields are utilised by Birmingham and its group of towns engaged in the hardware, small arms, and cycle industries. Wolverhampton, Dudley, Bilston and Walsall, all lie to the west of Birmingham; Redditch to the south.

The *Leicestershire* coalfield has many hosiery and lace factories, and shares with Northampton in the manufacture of boots and shoes. The *Warwickshire* coalfield serves Coventry and Rugby.

The *Somersetshire* coalfield meets the requirements of the shipping, sugar-refining, and tobacco industries of Bristol, as well as the "West of England" cloth factories of Stroud and Frome. The *Forest of Dean* also contributes.

The *South Wales* coal basin has the iron centres of Merthyr and Aberdare, and the copper-smelting and tin-plate industries of Swansea and Llanelly. It supplies anthracite to ships of all nations. Poorer coal and much ironstone are imported from Bilbao in North Spain, whilst copper-ore is brought from Huelva in South Spain, Cape Colony, U.S.A., and Chili.

The fringing *coalfields of the Welsh border* find outlets for their coal in Crewe (a great railway focus on the London and North Western system), the Birmingham group of towns, Kidderminster carpet factories, and the china works of Worcester.

The coastal strip of coal in *Cumberland* is well placed for serving Carlisle, Belfast, the Isle of Man, and the busy iron towns on the Furness shore of Morecambe Bay, of which Barrow is chief.

London and the Thames—away from the coal centres, but supplied by "colliers" from the Tyne and Wear, as well as by rail from nearly all the coalfields—have many factories for the making of leather, paper, hats, chemicals, soap, and glass.

Slate industries centre in North Wales and Cumberland, especially in the Snowdon (Bethesda, Llanberis, and Festiniog) and Skiddaw (Keswick) areas.

Tin has long been mined in the Cornish peninsula at Truro, Camborne, and Redruth.

Other industrial centres like York, Norwich, and Reading, Crewe, Bedford, and Yarmouth, will be dealt with in the local sections of Part II.

Ireland.—The three manufacturing districts of Ireland group around the ports of *Londonderry*, *Belfast*, and *Dublin*.

Londonderry has shipbuilding and linen industries. *Belfast*, the capital of Ulster, is the centre of the linen and calico-printing industry. It has also extensive shipyards. The coal distributing ports of Ardrossan and other Ayrshire towns in Scotland, and Workington with Whitehaven in England, deal largely in supplies for Belfast, Lisburn, Lurgan, and Newry. *Dublin*, the first city of Ireland, has poplin, silk and linen factories, and many distilleries. *Wexford* and *Waterford* gather up the agricultural produce of south-east Ireland. *Limerick*, *Galway* and *Donegal* serve as foci for the dairy markets and stone-quarrying industry of the west of Ireland. Hand-weaving has been revived as a home-industry.

CHAPTER VII.

Internal Communications by River, Canal and Railway.

[Maps to be studied: any good general map of the British Isles, together with railway maps.]

THE only rivers which give navigable access to the interior are:—

The Clyde and the Forth in Scotland;

The Ouse, Trent, Mersey, Thames and Severn in England;

The Shannon, Erne and Barrow in Ireland.

Dredging has greatly enhanced the commercial importance of many estuaries (*e.g.*, the Tyne).

Scotland.—The canalisation of the Scottish Lowlands became a great necessity with the development of the coalfield and the enormous growth of Glasgow. Now the *Forth and Clyde Canal* crosses the isthmus, some thirty miles, and gives the Clyde ports water access to the Forth, and so to continental ports. If deepened to carry ocean-going vessels, it would render a great service to Glasgow and its neighbours. Grangemouth is the eastern outlet.

The *Caledonian Canal* through the Great Glen is too far removed from industrial centres to be of great value. The *Crinan Canal* across the head of the Cantyre peninsula serves tourists for the Western Highlands.

Let us dissect the main lines, and trace their courses through industrial areas, noting the relation of track to physical features, and the "lines of least resistance."

The *Great Eastern Railway* serves the eastern counties by two main lines. The more easterly runs through Essex and

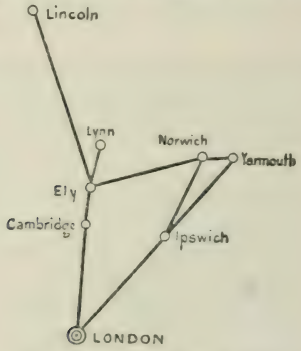


FIG. 172.—G.E.R. LINES.

Suffolk to serve Ipswich, Norwich, and Yarmouth. The other follows the valley of the Lea, and then the valley of the Ouse,

FIG. 173.—G.N.R. LINES.

on its way *via* Cambridge and Ely, to King's Lynn and Lincoln.

The *Great Northern* trunk line follows the course of

the Great North Road. It crosses one after another the streams which drain to the Wash—the Ouse at Huntingdon, the Nene at Peterborough, and the Witham at Grantham. It runs over the Trent at Newark, and along the red-sandstone plain to Doncaster. The *North Eastern Railway's* main line carries communication forward to Berwick. The whole system is then called the *East Coast Route*. From York it follows the Ouse, and then the Swale as far as Northallerton. It then continues

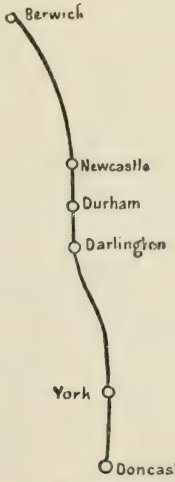


FIG. 174.—N.E.R. MAIN LINE.

through the Mid-Durham valley. calling at Darlington, Durham, and Newcastle. Soon it strikes to the Northumberland coast on its way to the border town. The *Great Northern Railway* radiates from Doncaster to meet the needs of the West Riding woollen towns and the Humber ports. The *North Eastern* sends off branches to the Pennine dales (including the Carlisle branch), and important lines to Scarborough, Middlesborough, Hartlepool, Sunderland, and the Shields.

The *Midland System* connects Leicester and Nottingham with London, and runs forward to Sheffield and Leeds. Taking advantage of the Aire gap it crosses the Pennines at Settle, and eventually descends the Vale of Eden to Carlisle. It gives off an important branch to Bradford. A recent important

FIG. 175.—M.R. SYSTEM.

development is the new harbour of Heysham, south of Morecambe Bay, to which a branch runs, and from which the company offers a daily service of boats to Belfast. Another important section links the trunk line with Derby, Matlock, and Manchester, traversing the charming country of the Peak

by way of the valley of the Derwent. A still further line joins Sheffield and Derby with Birmingham and Bristol. This follows the New Red Sandstone outcrop at the foot of the Oolite ridge.

The *London and North Western Railway* passes through Rugby and Stafford, and thence to Crewe and Warrington. It then follows the Lancashire plain to Lancaster and Kendal.

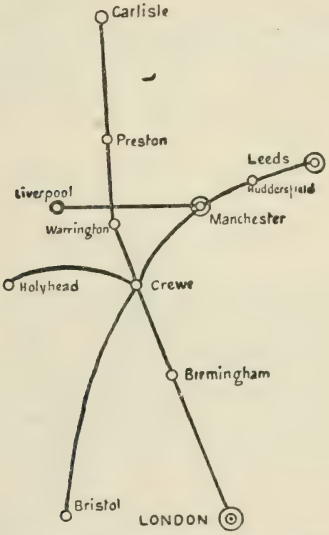


FIG. 176.—L.N.W.R. SYSTEM.

A stiff gradient carries the line over Shap Fells, in Westmoreland, after which its course follows a parallel valley to that of the Eden, on its way through Penrith to Carlisle. Penrith serves as a gate to the northern section of the Lake District. *Crewe* is the principal junction on the system. Branches almost as important as the main line are thrown off to Holyhead, Manchester, Leeds and Bristol. An important transverse line joins Liverpool with Manchester, and so with Leeds. Through trains carry the communication to Newcastle.

The *Cambrian Railway* serves the coast of Wales and links up the northern and southern systems of the Principality. The *Furness Line* similarly connects the Carlisle focus with the Cumbrian ports and watering places.

The *Great Central Railway*, the youngest of the mid-country systems, is a recent development of the earlier Manchester, Sheffield and Lincolnshire Railway. It links that

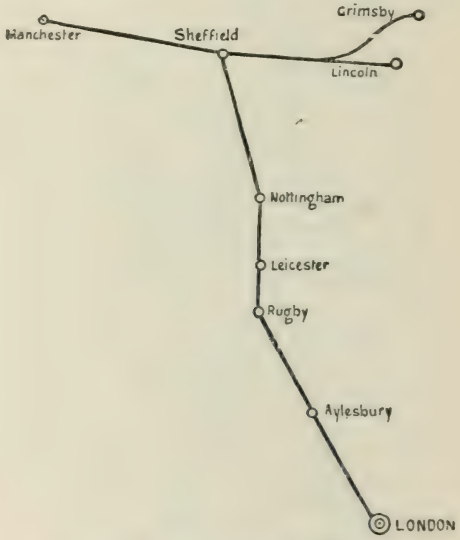


FIG. 177.—G.C.R. LINES.

transverse line, through Nottingham, Loughborough, Leicester and Derby, with London.

The *Great Western Railway* is the chief servant of the Thames Valley and the counties on either side of the Bristol Channel. It calls at Reading, Swindon and Bath. At Bristol it gives off the S. Wales line to Cardiff, Swansea and Milford, and Fishguard (for Ireland). The main line proceeds *via* Taunton to Exeter. It then takes the English Channel coast to Plymouth

and Penzance. Exeter is also well served by the *London and South Western Railway*, which then crosses the Great Western Railway, and proceeds around the northern base of Dartmoor to Plymouth.

FIG. 178.—G.W.R. SYSTEM.

The *London and South Western Railway* takes a more direct route to Exeter. It throws off two important branches to Portsmouth and Southampton. The former follows the Guildford gap in the Downs, and the latter takes advantage of the Loddon gap at Basingstoke. Salisbury, Yeovil and Honiton are interesting towns on the route.

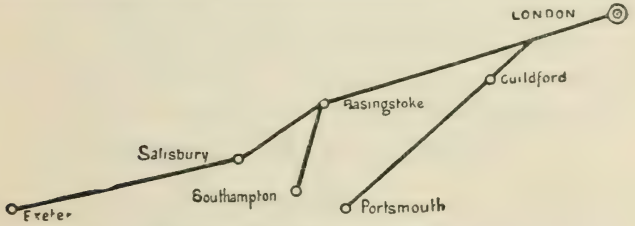


FIG. 179.—L.S.W.R. SYSTEM.

The *London, Brighton and South Coast Railway* runs due south to Brighton, and then links up the watering-places of the South Coast from Southsea to Dover. Newhaven is

The *Cambrian Railway* serves the coast of Wales and links up the northern and southern systems of the Principality. The *Furness Line* similarly connects the Carlisle focus with the Cumbrian ports and watering places.

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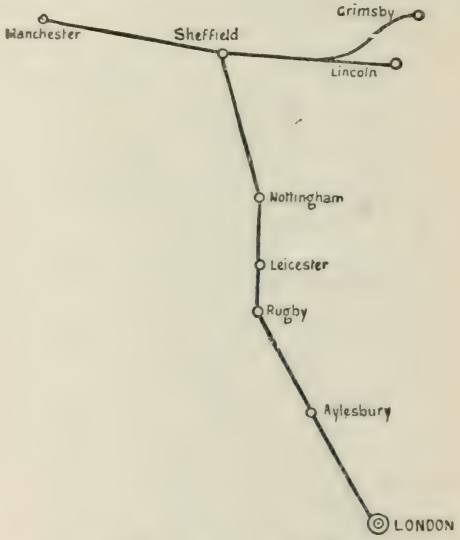

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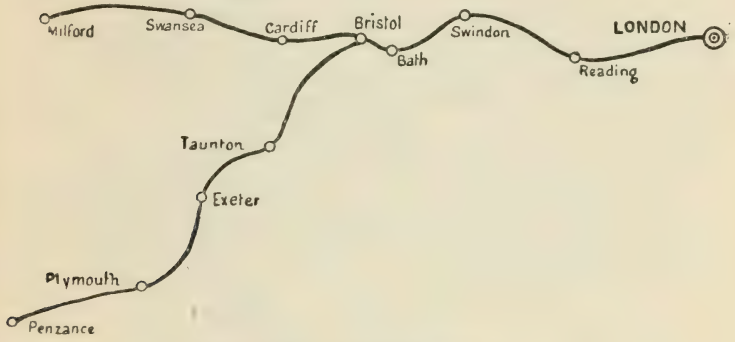

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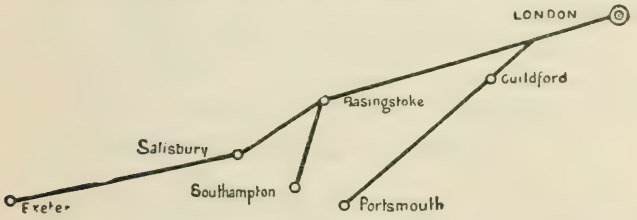


FIG. 179.—L.S.W.R. SYSTEM.

The *London, Brighton and South Coast Railway* runs due south to Brighton, and then links up the watering-places of the South Coast from Southsea to Dover. Newhaven is

an important packet station for the company's trains and boats. Dieppe is the corresponding French port.

FIG. 180.—L.B. & S.C.R. LINES.

The *South Eastern and Chatham Railway* serves the counties of the Weald. It includes the older systems of the London, Chatham and Dover Railway and the London and

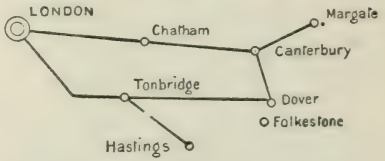


FIG. 181.—S.E. & C. RAILWAY.

South Eastern Railway. After crossing the North Downs by the gap of the Darent, the *south-eastern* section strikes along the axis of the Weald to Dover. At Tonbridge it gives off the Hastings line. A short branch serves Folkestone. The London, Chatham and Dover section follows the south bank of the Thames to Chatham. It proceeds to Canterbury, and thence divides to Dover and the Isle of Thanet.

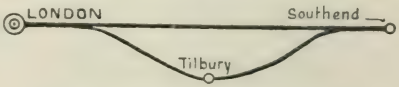


FIG. 182.—L.T. & S.R. LINES.

The *London, Tilbury and Southend Railway* runs special trains to meet the P. and O. steamers, which start from Tilbury Docks. It follows the Essex (north) bank of the Thames.

Railways of Scotland.—As we have seen, the railroad entries to Scotland are at Berwick and Carlisle. From the latter lines radiate as follows:—

(*a*) Across the Galloway lowlands to Stranraer and Port Patrick (easy of access to North Ireland).

(*b*) The Glasgow and South Western Railway, along the valley of the Nith to the Ayrshire coalfield and round *via* Kilmarnock and Paisley to Glasgow.

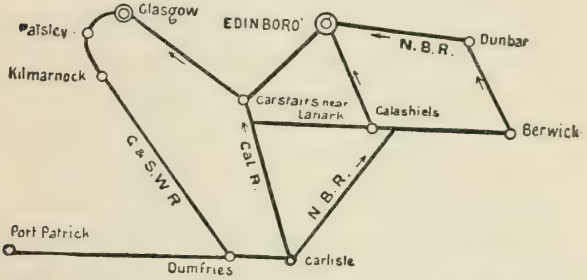


FIG. 183.—RAILWAYS CONNECTING GLASGOW AND EDINBORO' WITH CARLISLE AND BERWICK.

(*c*) The direct route of the Caledonian Railway up the vale of Annan and down the basin of the Clyde to Glasgow.

(*d*) The "Waverley" route, which traverses the Scott country (Abbotsford and Melrose) and the Tweed-cloth districts of Hawick and Galashiels on its way to Edinburgh. A transverse line follows the Tweed to Berwick.

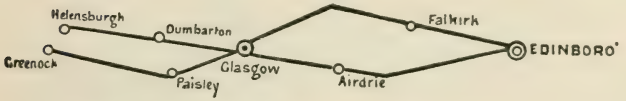


FIG. 184.—RAILWAYS ON THE LOWLAND COALFIELD.

From the eastern gate of Berwick the North British System carries the East Coast Joint System (E.C.J.S.) along the fine coast of the Firth of Forth to Edinburgh.

Between the two great centres of Glasgow and Edinburgh a maze of lines covers the busy coalfield. Direct routes call

respectively at Falkirk and Airdrie. A pair of railways serve the banks of the Clyde.

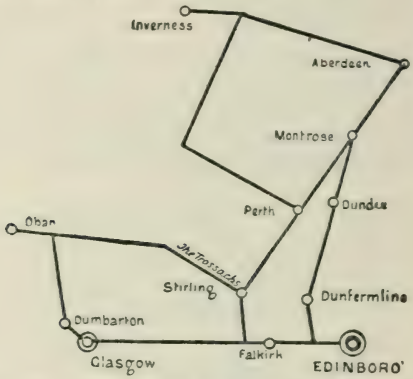


FIG. 185.—RAILWAYS TO THE EAST AND WEST.

North of the Lowland coalfield the East Coast Route continues *via* the Forth and Tay bridges to Dundee, Montrose,

FIG. 186.—THE HIGHLAND RAILWAYS.

Aberdeen and Inverness. Another line keeps south of the Forth as far as Stirling, and then divides into a western section for the Trossachs and the Highland tourist centre of

Oban, and a northern section which follows the plain of Strathmore as far as Perth. It then ascends the Tay basin, and descends the Spey valley on its way to Inverness. Oban is reached from Glasgow by the West Highland Railway *via* Dumbarton and the shores of Loch Lomond. (A branch crosses the Northern Highlands to Mallaig for the islands of Skye and Lewis.) From Inverness a line strikes northward across the Old Red Sandstone to the fishing ports of Wick and Thurso.

Railways of Ireland.—In so far as these are linked by steamer with Great Britain, we may regard them as radiating

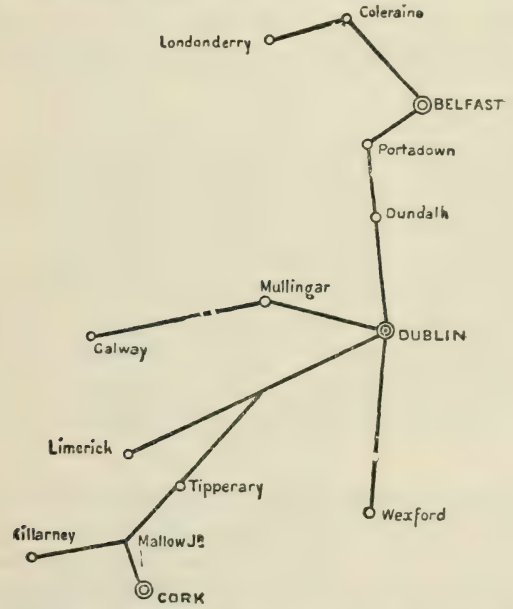


FIG. 187.—RAILWAYS RADIATING FROM DUBLIN.

from Belfast (in the north), Dublin (central), and Wexford and Waterford (south). They serve to link these ports on the landward side of the island with the ocean-facing ports on the west—Londonderry, Sligo, Galway, Limerick and Cork.

CHAPTER VIII.

The Export and Import Trade of the British Isles.

[Maps to be studied Maps of the British seas and the world's trade routes.]

SURROUNDED by seas on every side, open to the Atlantic on the west, and favoured with excellent harbours, the British Isles have taken first place in the shipping enterprise of the world. All the harbours of the world are visited by British ships. Flags of every maritime nation fly in British seas. Besides our great export and still greater import trade, the bulk of the carrying trade of the world is done by British vessels. Our ports are the gateways of commerce. Raw materials crowd into their docks; manufactured goods supply the cargoes of outgoing ships.

East Coast of Great Britain.—The east coast of the larger island faces successively the fishing centres of Norway, the stormy gates of the Baltic, the recent Kiel Canal, and the busy Continental trading towns of Hamburg, Rotterdam, and Antwerp. A series of cross-channel lines serves the multitudinous Continental traffic.

Aberdeen is the most northerly of the important ports. It forms an outlet for the products of neighbouring granite quarries, and for the harvest of the sea, gathered off its

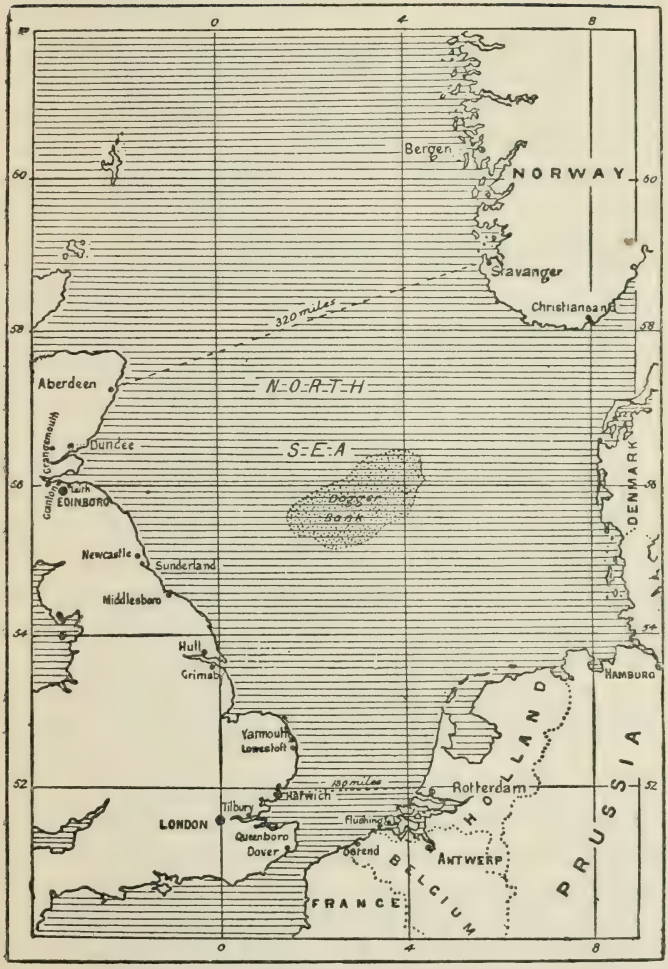


FIG. 188.—THE NORTH SEA AND ITS PORTS.

coasts or in far-off Arctic waters. It lies only 320 miles from Stavanger in Norway. Even Bergen is nearer than London.

Dundee and the *Tay ports* look toward the Baltic, and import immense quantities of flax, hemp, and jute from the lowlands of North Germany to serve the linen, canvas, rope, and sailcloth industries of the district.

Leith and *Granton*, ports of Edinburgh and *Grangemouth* at the Forth end of the Lowland Canal, serve as outlets for the busiest industrial area in Scotland.

Blyth, *Newcastle* and the *Tyne ports*, along with *Sunderland* on the Wear, export the immense surplus of coal supply from the Northumbrian coalfield. They import iron-ore from Sweden and Spain to serve the shipbuilding yards which crowd their river-banks, and timber from the Baltic countries for mining purposes.

Middlesborough is the port of the iron-smelting towns of the Tees valley. *Hartlepool* is noted for its timber imports.

Hull is the important outlet towards the Continent of the two industrial areas of the Yorkshire coalfield, as well as the gate of Ouse and Trent towns. Hither come wool from South Russia and Buenos Ayres, iron-ores from Sweden and the Spanish Biscay border, as well as timber from the Baltic, wheat from Hungary and the *black-earth* region of South Russia, and food-stuffs from the islands of the tropics. The most recent passenger route is from Hull to Zeebrugge. Grimsby lies across the Humber. It has a great trade in fish.

Harwich is an important packet station for the Hook of Holland, Hamburg, and Antwerp. The Great Eastern Railway Company has developed it.

London is the largest port, as well as the mightiest city in the world. Its imports are of every kind. One of the principal imports is wool from Australian colonies; another is petroleum from the wells of Baku. East Indiamen crowd the docks. All lands contribute their quota to the trade of the *Pool of London*.

On the Thames estuary stand the packet stations of *Tilbury* and *Queenborough* (for Flushing).

South Coast of Great Britain.—Between the Thames and Portsmouth stand the packet stations of *Dover* (South Eastern and Chatham Railway) for Calais and Ostende (Belgian Mail Route), *Folkestone* (South Eastern and Chatham Railway) for Boulogne, and *Newhaven* (London, Brighton, and South Coast Railway) for Dieppe.

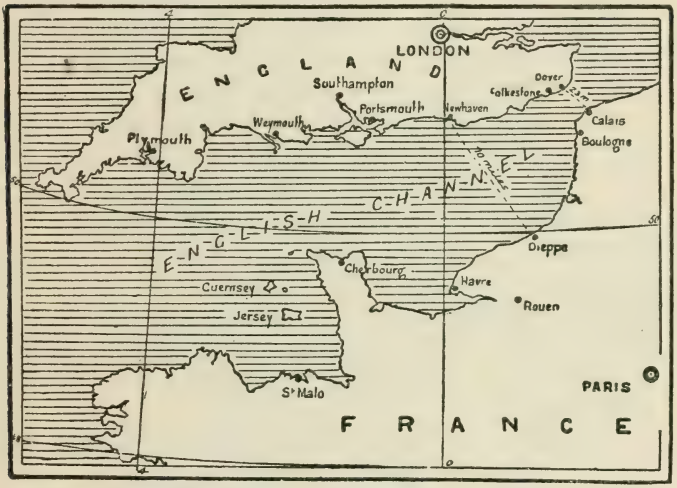


FIG. 189.—THE ENGLISH CHANNEL AND ITS PORTS.

Southampton, enjoying the advantage of a double tide—(*a*) from Spithead, (*b*) from the Solent—has developed into the most important packet station in the British Isles. Ships carry our mails to the Mediterranean, India, and the Far East; to the Cape and Australian colonies. Great liners from Hamburg and Havre call before crossing the Atlantic to American ports. By the enterprise of the London and South Western Railway, Southampton serves the Channel Islands, Cherbourg, and Havre.

Plymouth and *Portsmouth* derive their importance from naval rather than commercial causes. Plymouth is, however, a place of call for mail-boats sailing between London and the east-lying colonies, and some American lines.

Ports on the West of England and on the East of Ireland.—These serve as outlets for the Atlantic trade, especially with Spain, the West Indies, South America, the States and Canada.

Bristol has long been the medium of exchange between the West Indies and Great Britain. Tobacco and sugar from the Southern States, Jamaica and the Guianas have determined to a large extent the industries of the city.

With the development of the South Wales coalfield, *Cardiff* has advanced by leaps and bounds, until now it stands third among the ports of the British Isles, exceeded only by London and Liverpool. *Newport* and *Barry* are near neighbours.

Swansea shares with *Cardiff* (as we have already seen) the import of iron and poor coal from the north of Spain, and copper from the south of Spain, to serve the smelting works of the South Wales coalfield. *Pembroke* and *Milford* link the dairy-produce ports of Waterford and Wexford with the rail to London.

Holyhead is the nearest packet station for Dublin, which has its outport at Kingstown.

Liverpool and *Birkenhead*, on opposite shores of the mouth of the Mersey, and *Manchester* at the head of the ship-canal, export the products of the Lancashire cotton-mills and the chemicals, oils and soaps of the Mersey towns, as well as those fabrics from the Yorkshire factories intended for Canada and the States. They import corn and timber from Canada, cotton, bacon, builders' wood-work and raw oil from the States, as well as sugar and tobacco.

From *Liverpool* run the Atlantic "greyhounds," the finest vessels afloat, to Montreal, Halifax, Boston, New York, and Philadelphia, with the comfort and precision of a railway train.

Fleetwood (L.N.W.R.), *Heysham* (M.R.), and *Barrow* trade across channel with Belfast, Greenore and Dublin. Along with Liverpool, they serve the Isle of Man. *Derry*, too, has considerable trade with these Lancashire ports.

FIG. 190.—THE IRISH SEA AND ITS PORTS.

Whitehaven ships coal to Irish ports. *Silloth* is the port of the Solway.

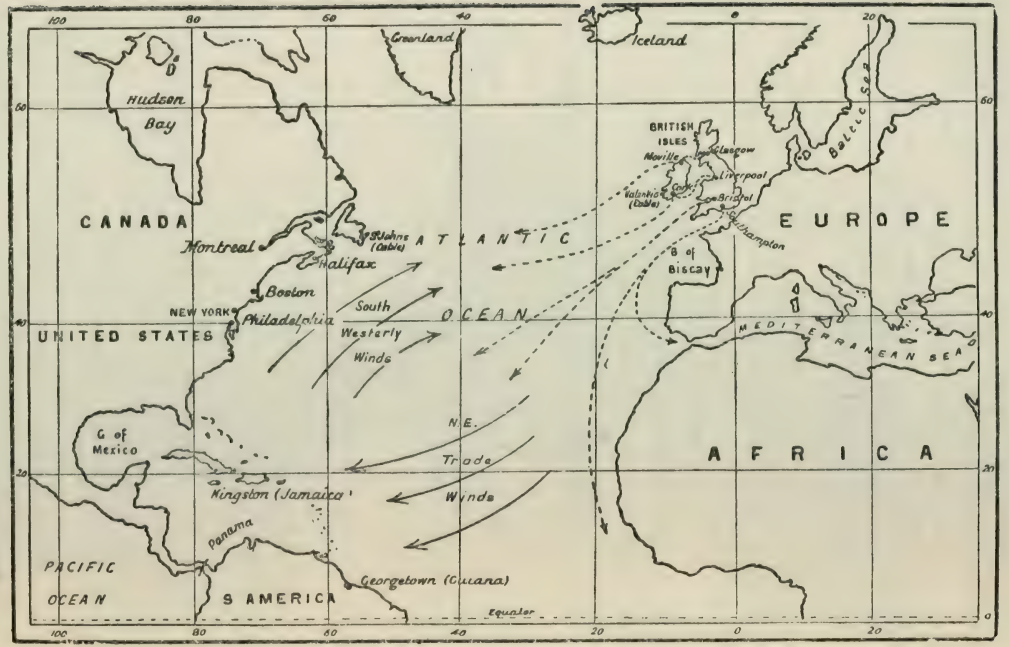


FIG. 191.—MAP OF BRITISH PORTS FACING THE ATLANTIC.

Atlantic Ports.—As *Liverpool* and *Bristol* are turned toward the Atlantic and the Americas, so *Cork* in the south of Ireland, *Moville* (the outport of Derry) in the north of Ireland, and *Glasgow* at the head of the Clyde estuary in Scotland, trade with Canada, the States, the West Indies and the South American Continent.

The *Clyde Ports* owe their enormous development to the shipbuilding yards, rather than to the business of their docks, considerable as that is.

Glasgow is nearer New York than Liverpool is by about sixty miles. Its liners call at *Moville* on their way to Montreal (for Canada) or New York (for the States).

Cork, the queen city of South Ireland, affords in her harbour of Queenstown an excellent port of call for the Liverpool-American steamships.

Galway, only three days' journey from the American coast, is ill-provided in its hinterland. It is chiefly important as a centre of the mackerel fisheries on the Atlantic sea-board. A Marconi station is set up here, and a movement is on foot to make Galway a port for Canada.

PART II.

A Series of Twenty-one Short Sections, giving Local Geography and Materials for the Building of Sketch Maps.

The arrangement necessitates some repetition, but this is an advantage, for the facts now appear in their Local rather than in their General setting.

PART II.

ENGLAND.

I.—Northumberland and Durham.

APPROXIMATE CO-ORDINATES OF NEWCASTLE : $55°\frac{1\frac{1}{2}°}{W.}$ N.

THIS area is shut in by the Cheviots on the Scottish border, the long wall of the Pennines on the west, and the Cleveland Moors of Yorkshire on the south. To the east lie the North Sea (400 miles wide) and Denmark.

Northumberland is a gentle slope seaward from the Cheviot igneous mass and the Pennine Axis, over which slope flow the parallel streams of the Aln, the Coquet, and the Blyth. The Tyne, which in its lower and busier reaches divides the two counties, receives streams from both groups of hills. The South Tyne starts at Cross Fell, the highest point in the Pennines, flows northward through the lead-mining district of Alston, and then descends in an eastward direction by the Tyne gap in the Pennines, to be joined by the North Tyne (from the Cheviots) at Hexham. The tide creeps up the river towards Hexham, thus making Newcastle a busy shipping outlet, capable of accommodating men-of-war in its river.

The course of the Wear, the principal river in the county of Durham, is out of parallelism with the general direction of these rivers, owing to the fact that in the eastern half of the

county of Durham the magnesian limestone, which runs along the eastern flank of the Pennines from Nottingham through Pontefract and Knaresborough, expands and culminates until it terminates in fine cliffs on the Durham coast. The Wear does, however, cut its way through from the city of Durham to the port of Sunderland, in a beautiful ravine.

The Tees forms the boundary between Durham and Yorkshire, and is more generally parallel to the Northumberland streams.

The uplands of all these rivers are similar in character—descending in terraces to the coalfields on the plain, yielding lead mines in the limestone bands, supporting many sheep and pasture farms. The valleys are visited for their woods and waterfalls. The coalfield which lies on the coastal sill of Northumberland, from the Coquet to the Tyne, outcrops in Mid-Durham, but is continued under the magnesian limestone of the Durham coast, where it is worked in deep borings. Iron-ore is fairly abundant. Cleveland supplies its quota to the numerous ironworks of Mid-Durham and the shores of the Tees estuary, but immense quantities of iron are imported from Sweden and Spain.

Rainfall is low along the coastal sill. Corn crops are grown with considerable success. Temperature is lower in summer, but higher in winter, than in London or East Anglia. The latter fact is worthy of remark, since the area lies 250 miles north of the metropolis.

The bulk of the population is to be found, of course, in the towns and mining villages of the coalfield, and on the estuaries of the more important rivers which serve as outlets.

The border town of Berwick is included in Northumberland, as well as Tweedmouth on the south side of the famous stone border bridge.

Flodden Field (1513) lies encircled by the river Till.

Wooler is a popular inland resort at the foot of the Cheviots.

Bamborough Castle stands on a volcanic remnant; the

Farne Islands, and Holy Island, with the Abbey of Lindisfarne, had a similar origin.

Alnwick is famous for its castle, the seat of the Duke of Northumberland and the scene of many a Border struggle.

Blyth is growing into one of the most important coal distributing ports in the county. Its export of coal amounts to over a million sterling every year. This has led to the Tyne ranking next to Cardiff among our English ports.

Hexham, at the confluence of the North and South Tynes, is a favourite inland resort. The Battle of Hexham was fought in 1464. The Roman wall is still to be seen to the N.W.

Newcastle is the industrial focus of the area. Gateshead stands on the opposite bank of the Tyne. Coal exporting, ship-building, engineering, ordnance factories, and chemical works are characteristic of the Tyne ports.

Jarrow and South Shields on the Durham side, Wallsend and North Shields on the Northumberland side, lie between Newcastle and the sea. Jarrow was the home of the Venerable Bede. The picturesque cliff of Tynemouth bears an ancient priory. North Shields has a considerable fishing trade.

Ironworks are especially plentiful between the Tyne and the Wear. Consett is a famous centre. Darlington is the centre of another group of ironworks. It lies between the coalfield and the iron-ore deposits of the Cleveland Moors.

Sunderland is the largest town in Durham and the principal port, standing at the mouth of the Wear.

The quaint old city of Durham, whose cathedral on a scarp overlooking the Wear ranks third in the country, is the home of a flourishing University.

The Hartlepools have an extensive trade in timber with the Baltic ports. Stockton-on-the-Tees shares in the iron trade, and is the outlet port for Darlington. Between these two towns Stephenson constructed his first railway.

The upper valleys of Tyne, Wear, and Tees are in close proximity to the centre of a lead-mining industry. The lower

valley of the Tees contains salt in the upper New Red Sandstone, which here finds its northern limit on the eastern side of the Pennines.

The North Eastern main line takes a direct northern course from York through Darlington and Durham city to Newcastle. From each of these towns it sends off a complete network of lines to the mining villages and the Pennine dales. From Newcastle it approaches the coast beyond Morpeth, and enters Scotland by the Berwick gate.

We have previously noted the line which carries traffic through the Tyne gap to Carlisle. The Waverley route (N.B.R. takes advantage of the North Tyne valley. Railways follow each bank of the Tyne from Newcastle to the Shields.

II.—The Eden Valley and the English Lakes.

APPROXIMATE CO-ORDINATES OF KESWICK: $54\frac{1}{2}° \begin{matrix} 3° \\ | \\ \text{N.} \\ | \\ \text{W.} \end{matrix}$

To the west of the Pennine Axis, and in an angle between the Pennines and the Southern Uplands of Scotland, rise the hills of the Ancient Cumbrian Group. The wedge-like Eden valley of red sandstone cuts them off from the Pennine Axis. The watershed runs from Scawfell to Helvellyn, the culminating points of the district. Rivers radiate northward to join the Solway or the Eden.

On the other side streams drain southward to Morecambe Bay. The ribbon lakes for which these valleys are famous are basins dammed at their outlets by glacial debris.

The Greta drains Thirlmere, Derwentwater, and Bassenthwaite lake as it flows around the base of the isolated slate mountains of Skiddaw and Saddleback.

Ullswater and Wast Water follow the line of the "divide" which passes through Scawfell and Helvellyn.

Coniston and Windermere (with Grasmere and Rydal Water) drain by independent streams to a common outlet in Morecambe Bay. The river Kent has no lake in its valley. The sandstone of the Eden valley lies in a faulted trough of Pennine rocks; the southern rim wraps round the northern side of Skiddaw, and terminates in the Cumberland coast and the Whitehaven coalfield.

The Lake District consists of a middle belt of volcanic rocks, with an older series of slate hills to the north (Skiddaw and Saddleback), and a younger series to the south. The grandest scenery is in the volcanic series, which includes the peaks of Scawfell, Langdale Pikes and Helvellyn. The upper ends of Derwentwater, Coniston and Windermere just touch the fringe of this volcanic belt. The lakes themselves lie in the slaty series. Ullswater, Wastwater and Thirlmere, however, fall within the central region.

Rainfall is exceptionally heavy in the hill-country. Borrowdale, which drains to Derwentwater, is the wettest, as it is one of the finest dales in England. Hill-pasture and meadow-lands make up the agriculture of the district. Moors cover the uplands. The Eden Valley is less rainy, more fertile, and more densely peopled. Agriculture is well advanced.

Keswick, at the foot of Skiddaw and the outlet of Derwentwater—the most beautiful of the lakes—is the centre for the northern lakes. It is served by a branch railway from Penrith to Cockermouth.

Southey, De Quincey and Coleridge lived in the neighbourhood. The falls of Lodore are near the head of Derwentwater.

Ullswater is best approached from Penrith. Ambleside, at the head of Windermere, is the centre for the southern lakes.

Wordsworth's home was at Grasmere. Ruskin lived on the shores of Coniston.

The southern district is served by the Furness line from Lancaster.

Kendal is the market town for the wool trade of the surrounding country.

Barrow is the great industrial centre of Furness.

Deposits of hæmatite have led to great iron works along the Furness coast of Morecambe Bay. Shipbuilding is an important industry.

The Eden takes its rise in the Pennine Moors, and passes Kirkby Stephen and Appleby on its way to the busy railway centre of Carlisle. Shap Fells are famous for their granite quarries.

The London and North Western Railway and the Midland Railway traverse parallel valleys in the Eden Basin on their way to Carlisle, and offer facilities for tourists to the Lakes.

A line of railway skirts the coast from Carlisle to Whitehaven, linking up the towns of the coalfield, Maryport and Workington. Silloth is the outport of Carlisle, and trades with Ireland and the Isle of Man.

III.—Yorkshire.

APPROXIMATE CO-ORDINATES OF YORK: 54° (1°) N. (W.)

LYING south of Durham, along the eastern flank of the Pennines, is the county of Yorkshire, the largest of the English counties.

Its projection beyond the line of the Northumberland coast in the Moors of Cleveland and the Wolds of the East Riding is due to the fact that these are the northern terminations of Secondary, or Mesozoic, ridges, which are unrepresented north of the Tees.

Yorkshire is thus made up of the Vale of York with the Pennine coalfield and uplands of the West, and Cleveland and the Chalk Wolds on the East. The outlet of the basin is the Humber, which traverses a break in the Mesozoic ridges.

The Pennine Axis changes in character as we trace it southward. In the dales of North Yorkshire we find a great development of sandstone (the Millstone Grit), and the limestone character is lost on the narrow strip of moorland between the Lancashire and Yorkshire coalfields. South of the latitude of Manchester, however, the Mountain Limestone reaches its finest development in this country, in the district of the Peak.

The great Yorkshire coalfield commences with the Aire Valley, and extends for sixty miles to Derby and Nottingham. The Aire and its tributary, the Calder, drain the northern portion of the coalfield. The Don and the Dearne drain the South Yorkshire section.

The North Yorkshire dales resemble in character those of the Wear and Tyne, though they are probably even more beautiful. Swaledale opens on the Yorkshire plain at Richmond, with its castle-crowned crag.

Northallerton (Battle of the Standard, 1138) and Thirsk lie in the lower basin of the Swale, and are important junctions on the Great North line.

Uredale, otherwise "Yoredale" or Wensleydale, is famed for its waterfalls and cheese. A transverse line connects the North Eastern at Northallerton with Hawes, on the Midland main line to Carlisle.

Nidd-dale contains the famous watering-place of Harrogate and the quaint old town of Knaresborough, with its dripping-well over a cliff of magnesian limestone.

Wharfedale is, perhaps, the most beautiful of all the dales. Ilkley is a tourist centre. Otley is an ancient market town Tadcaster, on the York plain, has many breweries.

The Swale and the Ure unite to form the Ouse, and the

Nidd joins before York is reached. The only considerable stream which joins the Ouse from the East is the Yorkshire Derwent, which draws its waters chiefly from the Cleveland Moors. Its valley, the Vale of Pickering, lies between the flat-topped hills of Cleveland and the rounded chalk hills of the Yorkshire Wolds. The source of the headstream is but a few miles from the hilly coast near Scarborough, and the valley affords easy access for a railway from York to the coast resorts. A smaller river, the Esk, drains to the sea at Whitby, along the northern slope of the Cleveland Moors. The streams of the Wolds drain south-east, along the slope of the chalk, to join the Humber.

The Wharfe, Aire and Don cross the New Red Sandstone Plain to join the Ouse below the city of York.

Rainfall is considerable on the Pennine pastoral uplands, medium on the sheep farms of the North York Moors and the Wolds, and distinctly low on the fertile plains of York and Holderness, with their alluvial soils.

The East Riding has a more extreme climate than the rest of the county.

Population is sparse in the North York Dales, considerable on the corn-lands of the Vale of York, and exceptionally dense in the two industrial areas of Leeds and Sheffield, with their groups of towns. The northern edge of the Cleveland country is thickly populated, owing to the iron industries of the Tees Estuary.

The woollen industry centres in the valleys of the Aire and Calder, which are on an excellent coalfield and within easy access of Liverpool and Hull. The historic town of Skipton in Upper Airedale has its wool fairs.

Keighley is taking an important part in the trade, and makes much machinery for woollen mills.

Bradford is the real centre of the woollen trade.

Leeds, the largest city on the coalfield, has other industries which contribute to its wealth—ironworks, leather tanneries,

boot and shoe factories, as well as the ready-made clothing trade.

Halifax, just north of the Calder, and Huddersfield, just south of the Calder (in the busy valley of the Colne), share with Bradford in the woollen industry.

Dewsbury and Wakefield also take their part. Wakefield is the seat of a Bishopric and the headquarters of the West Riding County Council.

Sheffield is the focus of the steel and cutlery trades of the Don valley. Rotherham, at the junction of the Rother with the Don, has many collieries and ironworks.

Barnsley has excellent coal and a linen industry. Doncaster, on the East Coast Route, is a railway centre of much importance, and has extensive locomotive sheds.

Contrasted with the busy, smoky West Riding, is the fertile Vale of York, floored with New Red Sandstone and mantled with glacial drift and rich alluvium.

The historic city of York, once the capital of England, and still the seat of an Archbishopric, combines its ancient dignity with immense railway development and trade in agricultural implements.

Selby and Goole are busy railway and canal centres.

The Humber, which commences at Goole, is the joint outlet of the similar and busy basins of the Ouse and Trent.

Hull (or Kingston-on-Hull) is the port of the Humber and the gateway of the Yorkshire traffic. It has great trade with Norway, the Baltic, Hamburg, Antwerp, and Russia, and has grown to be the fifth port in the British Isles.

The flat plain of Holderness runs out to the sandspit of Spurn Point; the escarpment of the chalk Wolds facing the Vale of Pickering juts out to sea in Flamborough Head, just north of Bridlington.

Beverley has a fine minster and several tanneries.

Malton is the great market centre for the Vale, and famous for its fruit. The North York Moors present steep cliffs to the

North Sea. Scarborough and Filey mark the southern end. Whitby and Saltburn the northern limit.

On the estuary of the Tees stands Middlesborough, the chief town in the Cleveland iron district.

York, Leeds, Doncaster, and Sheffield are the railway centres of the county.

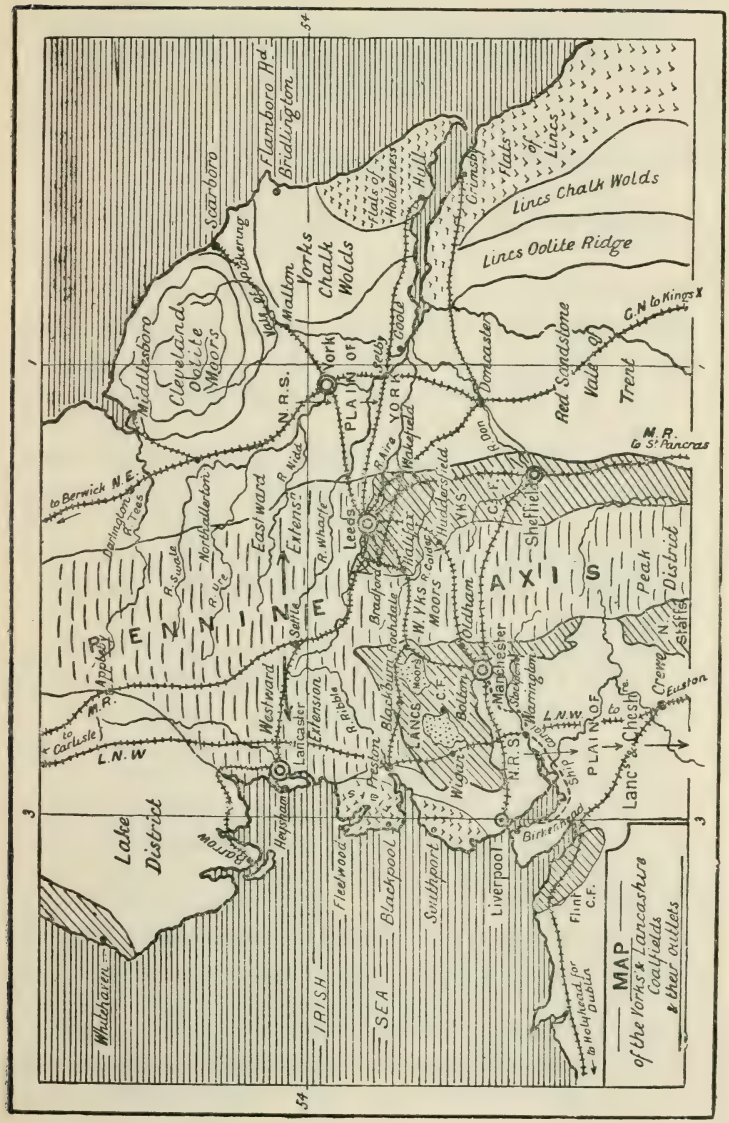
The North Eastern Railway takes a mid-course through the Vale of York on its way to Darlington and the North. It gives off branches to Hull, Scarborough, and Leeds. From Leeds a loop line crosses the outlets of the Yorkshire dales at Harrogate, Ripon, and Thirsk.

The Great Northern line turns off at Doncaster *via* Wakefield to end in Leeds and Bradford.

The Midland and Great Central Railways converge on Sheffield. The former proceeds by Leeds and Airedale, through the Aire gap, on its way to Carlisle. The latter continues beyond Penistone *via* Huddersfield and Halifax, over Lancashire and Yorkshire metals, to terminate at Bradford. Important lines connect Leeds with Manchester and Liverpool on the west, and Hull on the east.

The Lancashire and Yorkshire Railway follows the valley of the Calder *via* Halifax, whilst the London and North-Western Railway takes the valley of the Colne *via* Huddersfield.

The Leeds and Liverpool Canal traverses the Aire gap. The London and North Western Railway Canal from the Colne valley to Manchester, passes through a tunnel (three miles long) in the Pennines.


MAP
of the York's & Lancashire
Coalfields
& their outlets
Lake District
PENNINE AXIS
IRISH SEA
Lincs Chalk Wolds
Lincs Oolite Ridge
Red Sandstone Vale of Trent
Cleveland Oolite Moors
York Chalk Wolds
PLAIN OF YORK
PLAIN OF Lanc & Chesh
Peak District
N. Staffs
Flint C.F.
Wirks C.F.
Yorks C.F.
Lancs C.F.
Scarboro
Flamboro Hd
Bridlington
Middlesboro
Whitehaven
Maryport
Workington
Keswick
Penrith
Carlisle
Appleby
Darlington
Northallerton
Richmond
Ripon
Harrogate
Leeds
Bradford
Halifax
Huddersfield
Wakefield
Pontefract
Doncaster
Sheffield
Barnsley
Rotherham
Chesterfield
Derby
Manchester
Oldham
Bolton
Wigan
Preston
Blackburn
Burnley
Accrington
Rochdale
Liverpool
Birkenhead
Southport
Blackpool
Fleetwood
Lancaster
Heysham
Morecambe
Kendal
Grange
Whitby
Malton
Selby
Goole
Beverley
Hull
Driffield
Bridlington
Flamboro Hd
Scarboro
Thirsk
Ripon
Boroughbridge
Knaresborough
Tadcaster
Wetherby
Otley
Ilkley
Keighley
Skipton
Settle
Ingleton
Clitheroe
Colne
Nelson
Todmorden
Mossley
Ashton
Stockport
Macclesfield
Congleton
Crewe
Nantwich
Whitchurch
Wrexham
Chester
Runcorn
Warrington
Wigan
Leigh
Bolton
Bury
Rochdale
Oldham
Ashton
Stalybridge
Hyde
Glossop
Buxton
Matlock
Ashbourne
Uttoxeter
Stafford
Newcastle
Crewe
Shrewsbury
Wellington
Telford
Wolverhampton
Walsall
Dudley
Stourbridge
Kidderminster
Worcester
Evesham
Tewkesbury
Gloucester
Cheltenham
Stroud
Cirencester
Swindon
Oxford
Banbury
Rugby
Nuneaton
Tamworth
Lichfield
Burton
Derby
Nottingham
Mansfield
Worksop
Retford
Gainsborough
Scunthorpe
Grimsby
Louth
Boston
Spalding
Peterborough
Stamford
Grantham
Sleaford
Lincoln
Gainsborough
Doncaster
Pontefract
Wakefield
Dewsbury
Batley
Morley
Leeds
Bradford
Halifax
Huddersfield
Barnsley
Rotherham
Sheffield
Chesterfield
Mansfield
Worksop
Retford
Gainsborough
Scunthorpe
Grimsby
Louth
Boston
Spalding
Peterborough
Stamford
Grantham
Sleaford
Lincoln
Wolds of Lincs
Wolds of Holderness
Vale of Pickering
Vale of York
Vale of Eden
Vale of Lune
Vale of Ribble
Vale of Aire
Vale of Calder
Vale of Don
Vale of Rother
Vale of Dearne
Vale of Trent
Vale of Belvoir
Vale of Lincoln
Vale of Witham
Vale of Nene
Vale of Welland
Vale of Avon
Vale of Severn
Vale of Evesham
Vale of Gloucester
Vale of Cheltenham
Vale of Stroud
Vale of Cirencester
Vale of Swindon
Vale of Oxford
Vale of Banbury
Vale of Rugby
Vale of Nuneaton
Vale of Tamworth
Vale of Lichfield
Vale of Burton
Vale of Derby
Vale of Nottingham
Vale of Mansfield
Vale of Worksop
Vale of Retford
Vale of Gainsborough
Vale of Scunthorpe
Vale of Grimsby
Vale of Louth
Vale of Boston
Vale of Spalding
Vale of Peterborough
Vale of Stamford
Vale of Grantham
Vale of Sleaford

IV.—The Plain of Lancashire and Cheshire.

APPROXIMATE CO-ORDINATES OF—

MANCHESTER: $53\frac{1}{2}^\circ$ N. $2\frac{1}{4}^\circ$ W.

LIVERPOOL: $53\frac{1}{2}^\circ$ N. 3° W.

North Lancashire, comprising the valleys of the Lune and Ribble, is the western flank of the Pennines, stretching down to the sea. The hills of Ingleborough and Penygant are visible from Morecambe Bay.

Between the Ribble and the Mersey extends the Lancashire coalfield, corresponding in latitude with the Yorkshire coalfield on the other side of the Pennines. Skirting the coast and the edge of the coalfield is the red sandstone plain, which opens out in the plain of Cheshire, probably concealing a coalfield below.

The Weaver drains this plain, which is famous for its salt deposits. The up-raised Staffordshire moorlands cut it off from the contiguous basin of the Trent.

The flat coastlands of Lancashire on either side of the Ribble are covered with alluvium.

The Lancashire coalfield is interrupted by the uplifting of the underlying millstone grit, with the result that two groups of industrial towns have arisen—one to the north towards the Ribble, the other to the south, towards the Mersey.

The rainfall is greater than on the corresponding Yorkshire coalfield. The damper climate, which is due to more than average rainfall on a clayey soil, suits the cotton industry, of which this coalfield is the centre.

Agriculture thrives on the plain; pasture is good on the Pennine spurs.

The Lune and the Upper Ribble are famed for their scenery. Ingleborough, Penygant, and Whernside, the highest points in the Pennine Chain (except Crossfell), all stand near the source of the Ribble. Settle and Ingleton are favourite tourist centres in that limestone region. They both lie on the track of the Midland Railway through the Aire gap.

Lancaster is the historic capital of the county.

Morecambe is a popular resort for Lancashire and Yorkshire workers.

Heysham has recently opened docks (Midland Railway), with splendid steamers to and from the north of Ireland. It is a formidable rival to the port of Fleetwood, whence the London and North Western Railway have shipping communication with Belfast.

Blackpool is the busiest of the Lancashire resorts.

The Ribble estuary begins at Preston, one of the finest of the Lancashire towns.

Blackburn, Accrington, Burnley, and Colne form a northern group of towns with woollen in addition to cotton factories.

Bolton, Bury, Rochdale, and Oldham (north of Manchester), and Stalybridge, Ashton, and Stockport (south of Manchester), form the real centre of the cotton trade, the greatest of our manufacturing industries. Manchester is the great emporium; it is now a port by reason of the Ship Canal. The towns around Stockport make most of our felt hats.

Wigan exports much coal, and stands on the London and North Western main line, as does also Warrington.

Warrington has many chemical works. Runcorn and Widnes, also on the Mersey, share the chemical industry. The three towns lie within easy access of the salt deposits of the Weaver valley and the coal of Lancashire. The Ship Canal has enhanced their prosperity.

St. Helens has many glass works. Southport is a fashionable seaside suburb for Liverpool. Liverpool is the gate of Lancashire's immense trade and second only to London as an

English port. Birkenhead, on the Cheshire side of the Mersey, shares in the shipping activity of the Mersey as well as having soap and candle industries of its own.

The fertile plain of Cheshire, world-famed for its cheese, hemmed in by coalfields and probably itself overlying a connecting coal-basin, is the chief area in the British Isles for rock-salt.

Salt is associated with New Red Sandstone wherever the latter is found, but in Cheshire the deposits attain their maximum thickness. Nantwich, Northwich and Middlewich, whose names imply the salt industry, are the chief centres of the trade.

Crewe is one of the chief railway centres in the country, whence lines diverge to Manchester, North Wales and Mid-Wales, and through which the London and North-Western main line passes on its way to the North.

Chester, the quaint old capital of the county, stands on the silted-up estuary of the Dee.

Macclesfield and Congleton have silk factories.

V.—The Trent Basin.

APPROXIMATE CO-ORDINATES OF—

NOTTINGHAM: $53°$ N. $1°$ W. BIRMINGHAM: $52\frac{1}{2}°$ N. $2°$ W.

THE Trent basin roughly coincides with the red sandstone plain which sweeps around the base of the Limestone Pennines of Derbyshire. Along the Pennine flanks emerge the North Staffs and the Derbyshire coalfields, southward extensions of the Lancashire and the Yorkshire coalfields respectively. On

the plain itself the coalfields of South Staffs, Warwickshire and Leicestershire outcrop from beneath. The basin is divided from the Lancashire and Cheshire plain on the west and from the Severn basin on the south by slight upfolds of the rolling plain.

The lower Trent is remarkable for the absence of tributaries of any importance and for the due north direction of its course. It is overlooked on the east by the oolitic escarpment of the Lincolnshire heights.

The Witham cuts through a gap in these heights at Lincoln, and there is reason to believe that the Trent once flowed through this gap to the Wash.

The oolitic ridge yields iron-ore at Scunthorpe, and an iron industry has grown up at Gainsborough.

The chief tributaries of the Trent arise in the lovely Peak District of Matlock and Buxton.

The Dove and the Derwent dales are much frequented by tourists for their beauty of tor, gorge and cave, as well as for the bracing air and mineral waters of the tourist centres, which stand at a considerable elevation above sea level.

Kinderscout, the culmination of the Peak district, is a flat-topped mountain recalling Ingleboro' (a prominent hill in the Yorkshire dales), and it stands in a similar geological region.

The Tame and the Soar flow in from the south, the former from Warwickshire and the latter from Leicestershire.

On an affluent of the Tame stands Birmingham, the industrial capital of the Midlands. Both river valleys are followed by trunk lines of the Midland Railway from Derby, that along the Tame valley leading to Birmingham on its way to Bristol, that along the Soar valley calling at Leicester on its way to St. Pancras. The same railway uses the valley of the Derwent for its main line to Manchester.

The valley of the Trent is very fertile and has good pasture and cornlands. Rainfall and temperature are medium.

Great industries have sprung up on the numerous small

coalfields of the basin. The Staffordshire coalfield takes such a leading position in the earthenware and china industry as to be commonly called "the Potteries." The South Staffordshire coalfield with its iron-ore and readily available Dudley Limestone (for fluxes) has earned by its furnaces and factories the name of the Black Country.

The chief pottery towns are Hanley, Burslem, Stoke and Newcastle-under-Lyme.

Birmingham, the metropolis of the "Black Country," stands away from the coalfield, just within Warwickshire. It is the finest city in the Midlands, and is now the seat of a University and a Bishopric. Wolverhampton is the focus of the coalfield. Walsall, Wednesbury, West Bromwich, Redditch, and many other towns share the hardware, small arms, and cycle industries. The Severn valley is but ten miles away, and the district is canalised. (*See p.* 285.)

The valley between the two coalfields is drained by the Sow, on which stands Stafford, an important railway centre on the London and North Western Railway.

The Tame skirts the edge of the Warwickshire coalfield, of which Nuneaton is the distributing centre. Coventry, no longer busy with the silk weaving industry introduced by the refugee Huguenots, has developed a great trade in cycles and motor cars.

Ashby-de-la-Zouch is the chief town on the Leicester coalfield. South-west lie the peaks of beautiful Charnwood forest —a group of ancient mountains rising like islands out of a sea of red sandstone. Mount Sorrel is famous for its granite quarries.

The Soar valley contains the busy centres of Leicester and Loughborough. The former has a share in the boot and shoe industry of the Midlands. The latter has many electric tramway works. Both have lace and stocking factories.

Just above the confluence of the Derwent stands Burton

on-Trent, famous for its breweries, which were first established here because of the suitability of the gypsum-bearing waters of its springs. Newark, too, on the lower Trent, has many breweries.

Just below the confluence, at the focus of the plain, and at the southern extremity of the East Pennine coalfields, is Nottingham, the prosperous centre of the machine-lace, cotton-hosiery and tobacco industries. The river then follows in a northerly direction the boundary between the New Red Sandstone plain on the left, and the Lias clays on the right, at the foot of the Lincoln escarpment. It joins the Ouse from the corresponding sandstone plain of York at the head of the Humber, near Goole.

Newark has already received mention. Gainsborough ironworks have also been noted.

The Great Northern Railway enters the plain of the Trent at Grantham, crosses the river at Newark, and passes Retford on its way to Doncaster. A branch line runs from Grantham to Nottingham, Derby and Stafford. Worksop is the centre for the "Dukeries."

Clay Cross, the junction of the two trunk lines of the Midland Railway on the Derbyshire coalfield, has extensive ironworks. Chesterfield lies ten miles north of the junction.

Dovedale is considered the most beautiful of the Derbyshire dales, but the valley of the Derwent deserves special notice, since Derby and Matlock stand in it, and Buxton is in a tributary valley.

Derby is the headquarters of the Midland Railway, with immense locomotive works and carriage building factories. It has also silk-hosiery and porcelain industries.

The London and North Western main line serves the upper Trent and the Great Northern Railway the lower Trent. In addition to the Midland system, the Great Central Railway now has a trunk line from Sheffield for the south, through Nottingham, Loughborough and Leicester. The L.N.W.R. links Buxton and Ashbourne with Manchester.

VI.—The Rivers draining to the Wash.

Approximate Co-ordinates of Peterborough: $52\frac{1}{2}^{\circ}$ (+$\frac{1}{4}^{\circ}$) N. (+$\frac{1}{4}^{\circ}$) W.

Over the oolitic ridge from the Trent basin and lying between that ridge and the chalk escarpment is the trough which extends from Oxford to the Fens.

The streams of the Oxfordshire end of the basin drain transversely, and, after uniting to form the Thames, escape through a gap (which the river has developed whilst the weather has carved out the chalk escarpment) into the London basin. The three rivers, the Welland, the Nen and the Great Ouse, however, do not intersect the chalk but take parallel longitudinal courses down the trough through Fenland to the shallow basin of the Wash.

The Witham, which enters the trough from the Trent side of the ridge at Lincoln, also drains to the Wash. It is worthy of note that the Welland rises close to the source of the Stratford Avon, but the two streams flow off in opposite directions.

Though not of great importance as navigable rivers, any possibility of further development is prevented by their opening into the shallow sea of the Wash.

Boston, near the mouth of the Witham, and King's Lynn, at the outlet of the Great Ouse, have suffered from the silting-up of their channels.

The trough consists entirely of Mesozoic rocks—clays and limestone bands. In Fenland these are covered by alluvium. The clays and alluvium are useful in brick-making, and many brickfields have been opened and developed in the basin. The ironstone bands in the clays have given rise to ironworks, and the manufacture of agricultural implements (as at Kettering, Wellingborough and Peterborough), for agriculture is the staple industry of the three valleys. As it is an area of low

rainfall, it is admirably adapted for cereals. The low-lying meadows are damp and afford rich pasture, especially in Fenland. The angle of slope is so low that drainage becomes a pressing problem.

The low coast-lands of Lincoln, as well as the Holderness area of East Yorkshire, are extensions of the trough and share its general character. Temperature has a wider range than in the Trent basin. Winters are fairly severe, summers tolerably hot.

The Ouse has been canalised by the formation of the Bedford Level (not at Bedford but in the Fens, and named after two successive Earls of Bedford by whom it was carried out along with a scheme of drainage for the Fens). The Isle of Ely is a ridge of oolitic rocks (oolite and clay) rising out of the Fen lands.

The Cam, the river of the famous "backs" of the colleges of Cambridge, a tributary of the Ouse, cuts through the chalk *away from* the London basin, thus differing from the Thames and the streams of the North Downs, which flow *into* the London Basin. The Little Ouse takes a similar course.

The county of Lincoln has its heights, corresponding to the North Yorkshire Moors and Cleveland, and its wolds of chalk like the Yorkshire Wolds, and, like them, largely given up to sheep farms. The coast strip, as we have seen, is a southern extension of the alluvial flats of Holderness.

Grimsby, in Lincolnshire, corresponds to the Yorkshire port of Hull. Brigg is an inland market town. Louth, too, is an agricultural centre. In this neighbourhood Tennyson spent his youthful days.

Lincoln, the capital, has a fine cathedral, well placed on the oolite ridge. Boston's parish church tower, known to sailors as "Boston Stump," can be seen for miles out at sea.

The Welland serves, for a large part of its course, as a county boundary. Spalding is a Fenland town.

The Nen drains Northants and passes through the capital, Northampton, famous for boots and shoes. It also calls at the

implement-making towns of Wellingborough and Peterborough before crossing the Fens.

March is an important railway centre for the Fens.

The Great Ouse takes its rise within two or three miles of the sources of the Cherwell. On its banks stands Bedford, famous for straw-plaiting and hand-made lace, and connected with incidents in the life of Bunyan. Huntingdon, the town of Cromwell, quaint St. Ives, and Ely, the Cathedral city of the Fens, all stand on the Ouse.

King's Lynn, so named after the well-known hurried visit of King John, is the outlet town for this district.

Cambridge, the ancient University town, stands on alluvial flats amid the chalk hills of Gog and Magog.

The trunk lines from London all strike the trough transversely, entering by gaps in the chalk, or by deep cuttings and occasional tunnels.

The Great Central Railway crosses the headwaters of the Ouse at Brackley, just over the boundary between Bucks and Northants.

The Midland system links Bedford on the Ouse with Wellingborough on the Nen and the agricultural centre of Market Harborough on the Welland.

Kettering, with iron works, is also called at, and a main loop line leaves the trunk line at Market Harborough to link Oakham (the capital of Rutland) and Melton Mowbray with Nottingham.

The Great Northern Railway traverses the flat country north of Biggleswade, *via* Huntingdon (Ouse), Peterborough (Nen) and Grantham (on the Upper Witham), on its way to the busier area of West Yorkshire.

The Great Eastern Railway takes a direct course from London along the valley of the Cam and the plain of the lower Ouse, past Cambridge and Ely, to Lynn and Hunstanton, with its remarkable band of red chalk in the cliffs. From Ely an important line through March junction and Spalding (Welland) runs to Lincoln, whilst another leads eastward to Norwich.

VII.—East Anglia.

APPROXIMATE CO-ORDINATES OF NORWICH: $52\frac{1}{2}°$ N. $1\frac{1}{2}°$ E.

EAST Anglia, comprising (in our modern use) the counties of Norfolk and Suffolk, is essentially a chalk slope from the Chiltern—Gog-Magog ridge to the North Sea. Overlying the lower half of the slope is the northward extension of the London clay, itself capped by shell gravels and glacial deposits, which give the pretty cliffs of the coast from Cromer to the Naze. The whole area of clay and shell gravel is of Tertiary rocks, with no building-stone, ores or hard limestone. The clay is in parts rich in phosphates which serve as an excellent soil ingredient. Boulder clay is common, especially in Norfolk, mantling all the older stratified rocks. The slope is drained by a system of parallel streams (such systems being characteristic of the North Sea slope).

The Yare and the Waveney coalesce in the broads of Yar(e)mouth, after draining the county of Norfolk. An intermediate and older stream, the Little Ouse, cuts back westward through the chalk (as does the Cam) to join the Great Ouse in Fenland. The Stour and the Orwell in Suffolk also coalesce at Harwich, the packet station of the Great Eastern Railway, with its lines of mail-boats for the Continent (The Hook, Antwerp, Hamburg). In like manner to the Cam and the Little Ouse, the river Lark finds its way through the chalk ridge to the Great Ouse. The Colne drains North Essex, and the Blackwater and the Chelmer, rivers of Mid-Essex, coalesce at Maldon. The western and higher portion of the county of Essex, at some distance from the chalk ridge, which has

swerved to the west, drains by the river Lea along the boundary of the county to the Thames.

Norfolk and Suffolk differ from Essex in having regular coast lines. Essex shares the lower portion of the Thames estuary with Kent on the opposite shore.

East Anglia is the driest area in the country; it experiences hot summers and cold dry winters—the nearest approach to a Continental climate we possess. Its good soil and warm summers make it the chief corn-growing district in England. The highest part of East Anglia is occupied by the Gog-Magog hills. Bury St. Edmunds, Newmarket, and Saffron Walden are in the neighbourhood.

The absence of coal has resulted in the transfer of the worsted-weaving industry (introduced from Flanders) to the mills on the coalfield of West Yorkshire. Norwich still, however, remains a busy and flourishing city, with a fine cathedral. It has a special fame for mustard.

The large towns are essentially agricultural centres, with implement works. Monthly fairs are common. Yarmouth in Norfolk and Lowestoft in Suffolk, but ten miles apart, take the lead in the North Sea fisheries. Both, too, are popular holiday centres for Londoners.

The eastern counties main line divides at Ipswich, the historic capital of Suffolk. An inland line runs to Norwich and Cromer. The coast line, on its way to Yarmouth, gives off branches to the seaside resorts of Felixstowe and Lowestoft. The line to Ipswich takes a median course through Essex, calling at Chelmsford and Colchester, and giving off branches to the coast, the most important of which carries the daily Hook and Antwerp boat-trains to Harwich.

Southend is the nearest seaside resort to London. It has grown with enormous rapidity from a small fishing-village to a suburban town by the sea for London merchants. The London, Tilbury, and Southend line, and a branch from the Great Eastern Railway, serve the town.

The Great Eastern main line to Cambridge and Ely follows the Lea, and (therefore) the boundary of Essex past Waltham Cross and Bishop Stortford. In the angle between the two trunk lines stands the low range of Epping Forest, so fast being peopled by Londoners.

VIII.—The Thames Basin.

Approximate Co-ordinates of London: $51\frac{1}{2}°$ — 0° — N.

As we have previously seen, the London Basin is a wedge-shaped depression hemmed in by chalk hills. The Thames basin transgresses these ridges, however, by gaps in the chalk, and draws water from the trough between the Oolitic Cotswolds and the parallel chalk ridge of the Chilterns, as well as from the inner valley north of the Wealden Axis. In the former case the head-streams of the Thames converge to a focus on the plain of Oxfordshire, and the united stream flows through the picturesque gap in the chalk between Wallingford and Reading. The rivers on the Weald do not join up to form one stream, but take independent gaps in the North Downs on their way to the London basin.

Railways have utilised these cuttings, and towns of considerable importance stand in or near them.

The Cherwell and the Isis, which meet at Oxford, are the two chief streams of the Oxford plain. The Cherwell flows due south from Edge Hill; the Isis gathers up the streams of the Cotswold slope.

The Thame, which joins the Thames just before the latter enters the gap, flows along the base of the Chiltern escarpment in striking parallelism with the Stratford Avon (an affluent of the Severn) and in a directly opposite direction to the rivers

of the same trough, which drain to the Wash. The trend of the chalk-gap is a continuation of the Cherwell rather than of the Isis, and the axis of the London basin is followed by the Kennet (which flows in at Reading), rather than by either of the other streams. The Chilterns send in streams on the north, of which the Colne and the Lea are the most important, serving for considerable distances as county boundaries.

The Wey, the Mole, and the Medway flow in from the Wealden axis past Guildford, Dorking, and Maidstone in the chalk cuttings.

Lying in the chalk troughs of the London basin is the thick clay deposit known as London Clay, extending in wedge-like form as far west as Newbury on the Kennet. It represents the site of the Tertiary Estuary of the Thames. Nearly the whole of Essex is occupied by the deposit.

The heathlands of Aldershot and Wimbledon, and the tops of the hills around London, are caps of sand and gravel, younger than London Clay and once more widely distributed than at the present day.

The climate is warm, dry, and liable to gentle extremes. Cornlands, lowland pasture and immense farms of green crops for the supply of London markets are to be found in this basin. The heaths support flourishing pinewoods.

Coal and minerals, as well as building stones are absent from the London basin. The Cotswolds offer good freestone, and the Oxford plain has valuable cement beds. Oxford, the city of colleges and the seat of one of our two oldest universities, is the natural centre of the Upper Thames region.

Witney, on one of the streams of the Isis, has a blanket industry, fuller's earth being found in the district. Banbury is the chief town on the Cherwell, and stands on the important section of the Great Western Railway (from Didcot to Birkenhead *via* Birmingham) which follows the valley.

The Thame, in crossing Buckinghamshire transversely, passes Aylesbury, the capital, famous for its poultry farms.

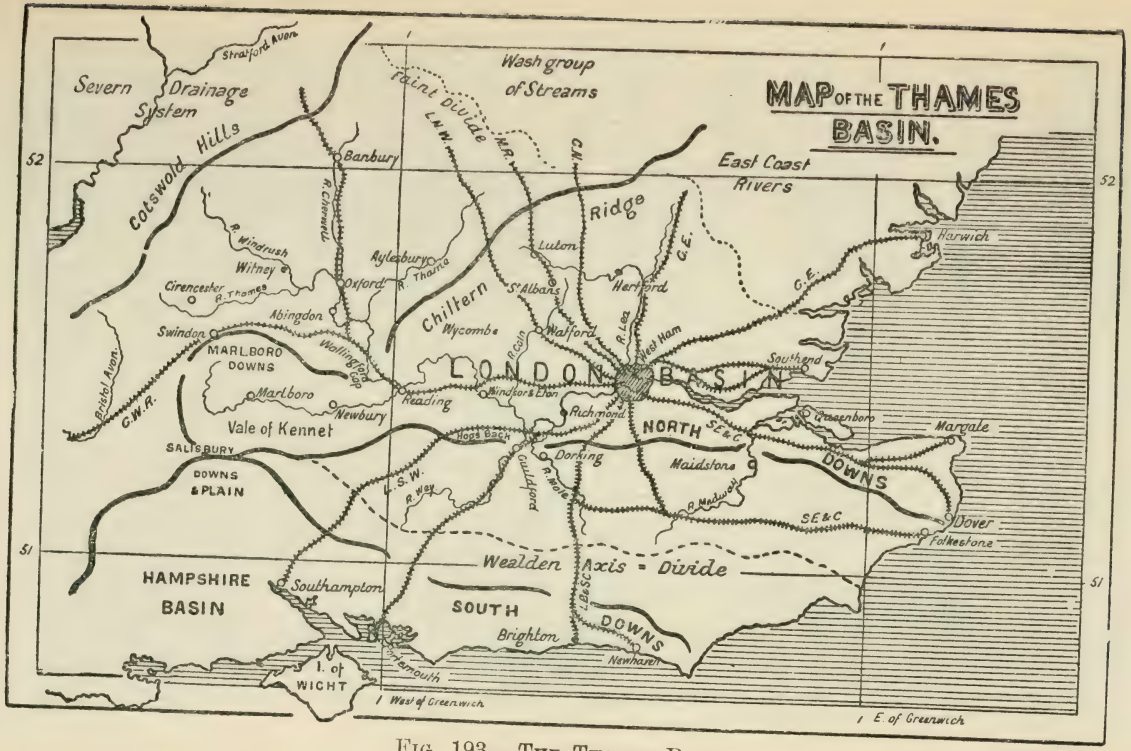


FIG. 193.—THE THAMES BASIN.

Abingdon is an agricultural centre. Swindon has great locomotive works in connection with the Great Western Railway. The vale of the Kennet is pastoral in character. Savernake Forest is one of the finest in the country.

Newbury and Hungerford are market towns. Reading, at the confluence of the Kennet and the Thames, is a prosperous town, with biscuit and other factories.

The slope of the Chilterns includes Buckinghamshire and Hertfordshire. High Wycombe has a speciality in the manufacture of chairs. Eton is known for its public school. Windsor, on the Berkshire side of the river, opposite Eton, is the chief royal residence.

The River Colne divides Middlesex from Buckinghamshire. Its upper course is in Hertfordshire, where St. Albans, a cathedral town on the Midland Railway, and Watford, on the London and North Western Railway, each stand at the crossing of railway and river.

Hatfield, the home of the Cecils, stands on the Great Northern Railway main line through Hertfordshire. The Lea divides Hertfordshire and Middlesex from Essex.

Middlesex has been almost absorbed by London suburbs. Surrey, too, north of the Downs is fast being covered with new centres of population, of which Croydon is largest. Aldershot and Bisley lie just within that portion of Hampshire which does not belong to the Hampshire Basin.

West Ham is a busy industrial centre contiguous to London on the east and divided from it by the River Lea. It has shipping, chemical, soap, and sugar-refining industries.

Woolwich and Greenwich stand on the south bank of the Thames some distance below London. The port of London ends with Tilbury Fort on the north side and Gravesend on the south bank.

No description of London is necessary or could be adequate. It is the focus of our railway systems, the busiest port on the globe, the centre of communication for the whole world.

The Great Western Railway main line serves the towns of the Thames Valley on its way to Bristol and the West Country. The London and South Western Railway, too, follows the Thames Basin as far as Aldershot and Basingstoke, as it proceeds to Exeter or Southampton.

Ships of all maritime nations crowd the *pool* of London.

IX.—The Weald of Kent and Sussex.

Approximate Co-ordinates of Tunbridge Wells: 51° $\frac{1}{4}$° N. E.

The Weald (or Woodland Country) of Kent and Sussex is an arched ridge dividing the London basin from the geologically similar Hampshire basin. (*See* Fig. 159.).

Originally the summit of the arch must have been chalk, continuous from the trough of one basin to that of the other; but denudation has truncated the arch, removing the chalk, from the borders of Hampshire to Dungeness and from the North Downs to the South Downs. We thus have an upland area with E.-W. axis gently sloping to the East and a chalk escarpment overlooking it on all sides except the seaward termination. The country is sandy and well watered; springs escape at the base of the chalk.

In olden times the Weald was (as its name implies) forest-land. Ashdown Forest is a remnant. The oval area of the Weald consists of two parallel canoe-shaped valleys running eastward on either side of the middle ridge and bordered on the outer side of the valley by the chalk escarpment. The escarpment of the North Downs terminates at Shakespeare Cliff and that of the South Downs at Beachy Head.

The Wealden Axis terminates in the sand-cliffs of Old Hastings. The floors of these upland valleys are Weald Clay.

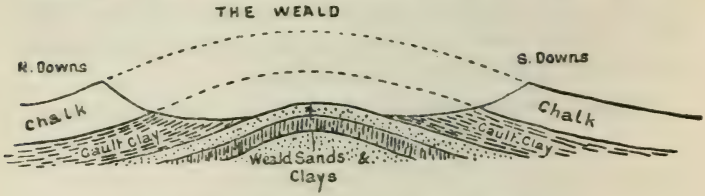


FIG. 194.—SECTION ACROSS THE WEALD.

The summit of the clay arch underlying the chalk has been exposed by denudation. The rivers do not, however, drain along these clay troughs to the sea, except in the case of the Rother, which would probably have been no exception, if the South Downs had continued eastward.

An older set of streams cut valleys in the chalk at right-angles to the axis (*i.e.*, north and south) and as the chalk and clay arches were gradually denuded, these valleys in the chalk became gaps. The new streams, on either side and parallel to the axis, would be tapped by the older streams, still keeping north and south directions through the chalk gaps. The result is a series of apparently rectangular bends in the streams opposite each gap.

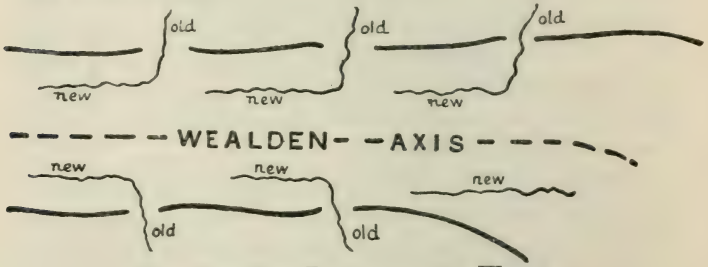


FIG. 195.—THE RIVERS OF THE WEALD.

The drainage of the Weald is thus exceptional and interesting.

The towns of the Weald are small, and either agricultural centres or inland resorts and sanatoria. They follow, in a

remarkable way, the narrow outcrop of the Greensand at the base of the chalk escarpment ring. They stand, too, at the outlets of the Weald, in the chalk gaps. Railways have availed themselves of these natural cuttings.

In the sands of the Wealden Axis some iron-ore used to be quarried, and ironworks once flourished in Ashdown Forest. The ironwork around St. Paul's Cathedral was smelted here.

The Chalk Wolds support many sheep farms, and the valleys of the Weald are famous for their hop gardens.

The coasts of Kent and Sussex are crowded with seaside resorts and packet stations for the Continent.

The low coast of North Kent is a strip of the London Clay continued eastward. The clay is well seen in the cliffs of Sheppey. The sea-shores of Kent and Sussex are of chalk, except between Dover and Eastbourne.

Of the streams which drain the northern half of the Weald, the Wey and the Mole are in Surrey.

The Medway is the chief stream in Kent and enters the Thames estuary through the Chalk Gap between Maidstone and Rochester. Rochester is the seat of a bishopric. Chatham has a naval dockyard. Port Victoria and Queenborough (in Sheppey) on opposite sides of the river are packet stations for Flushing. Sheerness is opposite Southend.

The Thames estuary, like the Essex rivers, is famous for oyster beds, and Whitstable takes premier place. Margate and Ramsgate, on the chalk promontory of North Foreland, are popular with Londoners. The Stour, which cuts through the North Downs between Ashford and the archiepiscopal city of Canterbury, divides into two streams, which convert the North Foreland promontory into the Isle of Thanet. Deal is a quiet resort. Dover is an ancient port, strongly fortified, a packet station for Ostende (70 m.) and Calais (25 m.) and the terminus of a railway system. Folkestone, at the seaward termination of the northern valley of the Weald, is a fashionable resort and a packet station for Boulogne (30 m.).

The flat sandspit of Dungeness has the powder factories of Lydd. Rye stands at the mouth of the Rother.

Hastings is a fine old town with splendid sea front, and is a great favourite with Londoners.

Eastbourne nestles under Beachy Head. Newhaven, on the other side of the chalk ridge, is a packet station for Dieppe (65 m.). Brighton is the largest seaside resort in the country, only 60 miles from London, due south. Behind the town run the Sussex Downs, parallel to the shore.

Following the greensand rim of the Weald along the base of the North Downs, we come to Godalming, on the Wey, and Haslemere, the home of Tennyson; then Dorking and Reigate, in the valley of the Mole and in the neighbourhood of the fine scenery of Box Hill; Sevenoaks, at the gap of the Darent; Maidstone, the capital of Kent on the Medway, and Ashford, an important railway centre on the Stour.

Crowborough Beacon is the culmination of the Weald.

Horsham has a fine school, which replaces the Old Christ's Hospital or Bluecoat School in London.

Tunbridge Wells is a popular health resort, 500 feet above sea level.

The railway system of the Weald is in the hands of the South Eastern and Chatham Railway and the London, Brighton and South Coast Railway.

The former includes the Chatham and Dover Railway along the London Clay of the Kent coast to Chatham, Canterbury, Margate and Dover, and the South Eastern Railway, through Tonbridge Junction, along the northern valley of the Weald to Ashford and Folkestone, or over the Weald to Tunbridge Wells and Hastings.

The London, Brighton and South Coast Railway makes due south for Brighton, with an important branch through ancient Lewes, the capital of Sussex, to Newhaven.

A coast section links up Brighton with all the channel resorts from Portsmouth to Hastings.

X.—The Hampshire Basin and the Isle of Wight.

Approximate Co-ordinates of Southampton: $51°\frac{1\frac{1}{2}°}{W.}$ N.

A glance at the geological map will show that the Hampshire Basin is a reproduction on a small scale of the physical features of the London Basin. A trough of chalk is filled with a basin of clay (Bognor Clay, the equivalent of the London Clay).

Corresponding with the line of the Thames in the London Basin we have here a sea channel, that of the Solent and Spithead. The rivers of the basin converge on this channel much as the rivers of the Thames valley converge on the main stream.

We find the Stour and the Avon, the Itchen and the Test, on the north, and the Medina and the Yar on the south (*i.e.*, from the Isle of Wight).

The two channels form gateways to the basin and detach the Isle of Wight from the mainland. The apex of the channels is at the entrance to Southampton Water. Owing to two tidal waves reaching Southampton at different times, the docks are always full and able to carry ocean-going steamers. Hence Southampton has become the principal packet station in the South. Ships start for the Cape, India and the Far East, and the Australian colonies. Continental liners for America call.

During the summer, steamers connect Yarmouth with Lymington, one of the gates to the New Forest.

Bournemouth is a popular health resort. The Stour, from the Dorset Downs, and the Avon, from the Wiltshire chalk

plateau of Salisbury Plain, unite and enter the sea at Christchurch. Salisbury has a fine cathedral. The stone circle of Stonehenge (hanging stones) is on Salisbury Plain.

The basin of the Frome represents the western limit of the clay basin. It is in Dorsetshire, and Dorchester, the capital, stands in the middle of its basin.

Poole Harbour is sheltered on the south by the oolite ridge of St. Alban's Head. Portland represents an older portion of the oolite-terminating headlands on the south coast. The "isles" of Purbeck and Portland yield valuable freestone.

Swanage and Weymouth are watering places. Lyme Regis,

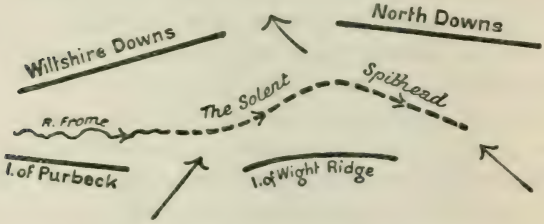


FIG. 196.—THE HAMPSHIRE DEPRESSION.

a quaint seaside resort, stands outside the Hampshire basin, but outliers of chalk cap the neighbouring hills.

The Hants-Dorset basin is served by the L. and S.W. Railway. Striking the basin at Basingstoke, the main line proceeds along the Downs, *viâ* Salisbury and Wilton (of carpet fame), through Yeovil (in Somerset) to Exeter. It throws off branches to every part of the basin, the most important being those to Portsmouth, Southampton, and Weymouth. Weymouth is also served by the G.W.R. From the two latter lines of steamers run daily to the Channel Islands and the French ports of St. Malo, Cherbourg, and Havre.

If we carry the analogy with the London Basin still further, the Dorsetshire Frome probably corresponds to the Thames. The space between St. Alban's Head and the Needles would correspond to a gap invaded by the sea. Spithead expands

into Portsmouth Harbour. Selsea Bill recalls the clays of Sheppey.

The climate of the basin is not so extreme as that of the London Basin, owing to the tempering influence of the English Channel. The basin is fertile; rich meadows line the Hampshire coast. Remnants of forest land are found in the New Forest of West Hampshire.

Coal and minerals are absent. The Bognor Clay is overlain in the north of the Isle of Wight by hills composed of strata practically unrepresented elsewhere in the British Isles, but plentiful in the Paris Basin, and characterised by fresh-water limestones, which in places (Bembridge) are hard enough to serve as building stones.

The Hampshire Downs drain by means of the River Loddon to the Thames. Basingstoke, in the gap, is an important railway and agricultural centre. Winchester, once the capital of England, has an ancient school and is the seat of a bishopric. Eastleigh, near Southampton, has important railway works. Southampton has already been noted. Portsmouth is the headquarters of the Channel Fleet. Gosport and Southsea are extensions of the old town.

Ferries ply between Portsmouth and Ryde, on the Isle of Wight. Cowes, of regatta fame, stands on the Solent, opposite Southampton Water. Sandown and Shanklin are popular holiday centres. Ventnor is a health resort on the steep southern slope of the Downs. The chalk cliffs of Freshwater Bay run out to the chalk stacks known as the Needles.

Of the distant Channel Isles—physically belonging to France, but politically to England—Jersey and Guernsey are largest. St. Peter Port in the latter and St. Helier in the former are the principal outlets for the fruit, dairy produce and road-metal exported.

XI.—The Cornish Peninsula.

APPROXIMATE CO-ORDINATES OF PLYMOUTH: $50\frac{1}{2}°$ N., $4°$ W.

THE county of Somerset, contiguous with Dorset on the north, is best considered with the Severn Basin and the Bristol Channel. Our use of the term Cornish Peninsula will refer to the counties of Devon and Cornwall.

The cores of the two counties are a system of granite bosses projecting up through slaty country or ancient limestone. Dartmoor is the most conspicuous group in the system. Bodmin Moor is a Cornish example. Between Dartmoor and wild Exmoor lies a country of sandstone resembling in age and character those of the coal measures, but devoid of coal. Land's End and the Lizard are igneous masses. Start Point is a headland of crumpled rocks of Grampian (or Brittany) type. Somersetshire claims a large share of Exmoor.

The limestones of Cornwall and South Devon (as far as Dartmouth) are of the same type as those of the older Ardennes and the Eifel, in the same latitude on the continent, and represent ancient massive-coral reefs. Quarried, they yield commercial "marbles" for mantels, fireplace fixtures and interior-wall decorations.

The weathering of the granite has led to deposits of excellent kaolin (china clay) in the valleys at the foot of the tors (Tamar Valley and Bovey Tracey).

The eastern fringe of the peninsula is a streak of New Red Sandstone continued southward from the vale of Taunton. It gives the characteristic red cliffs of the Devonshire coast as far west as Tor Bay. This strip of country is the most fertile part of the peninsula. Hill pastures cover the rest of the peninsula.

Associated with the Cornish granite bosses are valuable "lodes" or "veins" of tin ore. Mining operations still prosper though many veins are worked out.

Cornwall has the mildest winter climate in England, averaging 6° F. warmer than London and 12° above freezing for January. Its summers are genial, though 2° or 3° cooler than London. The range for the year is only 16°. Considerable rainfall and proximity to the sea are responsible for this.

The Scilly Isles grow great quantities of "early" flowers and vegetables for the London market.

The rivers of Devonshire show a somewhat unexpected parallelism in their courses. The Exe rises in Exmoor, passes Exeter and joins the English Channel at Exmouth. The Dart, similarly, rises in Dartmoor to end at Dartmouth. It is considered the most beautiful river in England.

The Taw and the Torridge, between the Exe and the Dart, drain in the opposite direction to Barnstaple Bay.

The Tamar, running parallel with the Dart, serves as the county boundary.

Exmoor descends steeply to the Bristol Channel; Lynmouth and Ilfracombe are exceptionally fine seaside resorts. Barnstaple and Bideford are old fashioned towns on a common bay. Clovelly, on the south side of the bay and sheltered by Hartland Point from Atlantic storms, is one of the prettiest villages in England. Lundy Island is the remnant of an old volcanic outburst.

The Great Western Railway and London and South Western Railway main lines from London converge on Exeter. The Great Western Railway takes the channel coast forward to Plymouth and Penzance. The London and South Western Railway follows the northern base of Dartmoor and the valley of the Tamar to Plymouth.

Okehampton and Moretonhampstead are centres for exploring Dartmoor. Exeter has a fine cathedral. Sidmouth,

Exmouth and Teignmouth are popular resorts on the red sandstone coast.

Torquay is the queen of western watering places. Brixham, across Torbay, is a quaint fishing town, famous for the landing of William of Orange and for its remarkable stalagmite cave. It sends out more trawlers than any other port on the Channel.

Plymouth makes, with Devonport and Stonehouse, a busy industrial centre and the finest town on the peninsula. The Hoe is famous for its connection with Raleigh and Drake in the days of the Spanish Armada.

Truro is the seat of a bishopric. Redruth and Camborne are mining centres. Falmouth has fisheries and is much frequented by artists. Penzance is the principal centre for Land's End, St. Michael's Mount and the Scilly Isles.

XII.—The Basin of the Severn.

Approximate Co-ordinates of Bristol: $51\frac{1}{2}°$ — $2\frac{3}{4}°$ W. — N.

The Severn and its tributaries drain the slaty uplands of Mid-Wales and the Old Red Sandstone slope of the border counties. The Severn itself rises in the Plinlimmon group, twenty miles from Cardigan Bay, and receives at the border the equal stream which now supplies water to the city of Liverpool—the Vyrnwy.

It then follows the New Red Sandstone fringe just east of the hill country, through the small coalfields which outcrop from beneath, to the estuary of the Bristol Channel. Its main tributary from Wales, the Teme, drains along the southern side of the Shropshire ridge of the Longmynd, serving as a

county boundary and passing Ludlow on its way to join the Severn below Worcester. The Avon, which is the only considerable tributary on the left bank, follows the eastern fringe of the Midland Plain over New Red Sandstone and Lias Clay, along the base of the Cotswold escarpment to the Severn, in a direct line to the Bristol Channel. This is the Stratford Avon, so named from the birthplace of Shakespeare.

The Rivers Wye and Usk, which are parallel streams to the Bristol Channel flow around the rims of the South Wales coalfield and its Forest of Dean outlier.

The Bristol Avon and the Tone flow in from the opposite side. The former has a curious course, rising to the east of the Cotswolds, and curving around their southern extremity to flow due west to the Bristol Channel.

The Tone and the Parret drain the flats of Somersetshire south of the Channel.

The beautiful Malvern Hills divide the Severn valley from the Wye.

The steep escarpment of the Oolitic Cotswolds follows the line of the Stratford Avon and lower Severn.

The volcanic mountain of the Wrekin stands north of the Severn in Shropshire. Hill pasture and moorlands cover the rolling uplands. Orchards abound in the counties of the lowlands. The terraced slopes of the Cotswolds support many sheep-farms, and Stroud, at the foot, is a centre of the woollen industry. It specialises in khaki, hunting, and billiard tables. The Cotswolds, too, yield valuable building stone—the freestone of Bath being about the best English stone.

The coalfields of the Mid-Severn valley, between Shrewsbury and Worcester, serve the great Midland industries; Wolverhampton is but 20 miles away.

The vale of Worcester resembles the vale of Cheshire in its salt-bearing strata. North Somerset has valuable coal deposits more or less concealed by the New Red Sandstone of the plain.

The East-and-West Axis of the Mendips is of ancient

limestone like that of the Peak District, and in a similar way divides the coalfields into two parts. Caves, too, are common, Cheddar being especially noted for its caves as well as for its cheese. The marsh lands of South Somerset offer valuable pasture. The lovely Quantocks and the flat-topped Blackdowns enclose the fertile vale of Taunton Dene.

The climate of the Severn Basin shows no distinctive features; it is neither extreme like that of East Anglia nor insular like that of Cornwall. Rainfall is most excessive on the uplands and below normal in the neighbourhood of Hereford.

The Upper Severn Valley has the flannel-making centres of Newtown and Welshpool, within the Principality. Shrewsbury is the capital of Salop and an agricultural centre. Wellington and Coalbrookdale stand on the coalfield. Coalport is a pottery centre. On the borders of Hereford and Shropshire is the battlefield of Mortimer's Cross, 1461.

The Plain of Worcestershire has Kidderminster, of carpet fame, and Droitwich, a salt mining town, at its northern end, only some fifteen miles from Birmingham, which lies on the other side of the Clee Hills. Worcester stands in the middle of the plain. It has a cathedral and some valuable potteries. Great Malvern overlooks the plain from the west.

The Stratford Avon rises above Rugby and passes Kenilworth Castle, the fashionable resort of Leamington, and the ancient city of Warwick. Stratford stands ten miles lower down the river. The battlefields of Evesham and Tewkesbury are on the plain. Edge Hill stands south of Stratford. Cheltenham lies away back from the Severn, at the foot of the Cotswolds, which culminate in Cleeve Cloud, not far away. Gloucester, the capital of the county, is connected by canal with Berkeley, on the estuary of the Severn.

The Wye and its tributaries drain the county of Hereford. One tributary is utilised for the Birmingham water supply.

Below Hereford, the river Wye becomes exceptionally fine

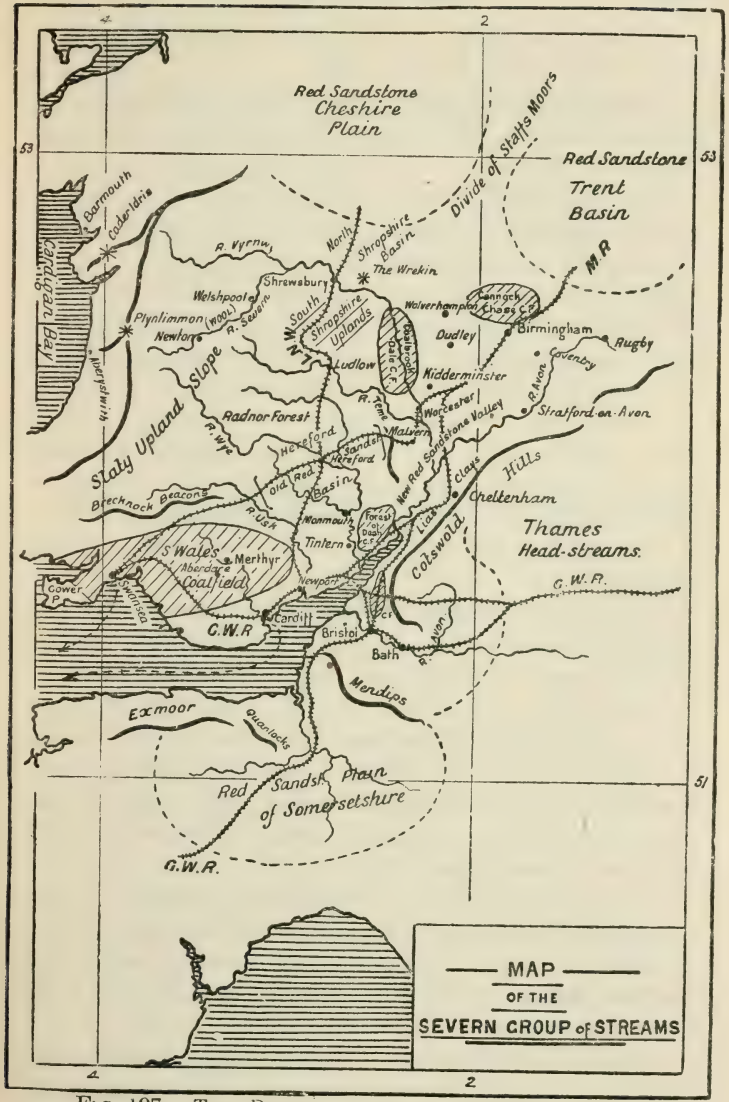


FIG. 197.—THE BRISTOL CHANNEL DRAINAGE AREA.

as it cuts its way through the limestone on the western rim of the coalfield of the Forest of Dean.

Ross and Monmouth are picturesque towns in different counties. Tintern Abbey has a fine position, as also has Chepstow Castle.

The Usk, draining from the wild moorlands of Brecknock, takes a middle course through Monmouth to Newport, on the Channel. The Bristol Avon drains the Oolite slope of the Southern Cotswolds, and curves round through the plain between the Cotswolds, and the older Mendips, over the Bristol coalfield, and escapes by the Clifton gorge to the Severn ten miles below the city of Bristol.

Bath is one of the oldest towns in the country. Once a Roman town and still retaining its baths supplied by warm springs, it keeps up with more recent cities. Its fine stone houses have been built from materials close at hand. Bradford and Trowbridge, just within Wiltshire, have cloth weaving industries.

Bristol is a fine city with tobacco, sugar refining, and brewing industries, and considerable shipping trade with Trans-Atlantic ports. It is also the outlet of the Somersetshire coalfield.

The Mendips (or Mine-deeps) have caves and lead veins like their Derbyshire equivalents. Wells is a cathedral city. Frome shares the broadcloth industry with Bradford and Trowbridge in the neighbouring county. Weston-super-Mare stands at the seaward end of the range.

The flats of the Parret are given up to pasturage. In the vale of the Tone stand Taunton (Tone-town), the capital of Somerset, the scene of Judge Jeffreys' Bloody Assize [1685], and Wellington, on the borders of Devonshire, with its mills for the manufacture of woollen serge.

The Quantocks, beloved of Coleridge and Wordsworth, who lived for a time at Nether Stowey, run down to the sea at Watchet.

Minehead, further along the coast, lies at the foot of Exmoor.

The western main line of the Midland Railway strikes the Severn valley below Birmingham, and serves Cheltenham and Gloucester on its way to Bristol.

The Great Western Railway main line follows the Bristol Avon valley from Swindon, through Bath, to Bristol. It then proceeds *viâ* Weston, Bridgewater and Taunton, to Exeter and Plymouth. A joint line (L. and N.W. and G.W.) serves the Welsh border counties by a line from Crewe, through Shrewsbury, Ludlow, Hereford, and Newport, on its way to Bristol, *via* the Severn Tunnel.

XIII.—South Wales and its Coalfield.

Approximate Co-ordinates of Cardiff: $51\frac{1}{2}°$ N., $3\frac{1}{4}°$ W.

West of the river Usk, along the northern shores of the Bristol Channel, stretches the basin of the South Wales coalfield, for a distance of eighty miles. The basin has been invaded by the sea in the bays of Caermarthen and Swansea. The Milford and Pembroke Peninsula and the Gower Peninsula (projecting from Swansea to Worms Head) are remnants of the invaded belt, preserved by up-folding.

The coal in these peninsulas is largely converted to anthracite as a result of the folding process. The middle of the basin is not a trough but a range of coal-bearing sandstone hills running E.-W. along the basin.

This gives us two industrial centres, one in the valley to the north around Merthyr and the other along the seaboard around Swansea.

The two valleys are followed by railways from Pontypool and Newport to Swansea. Many branch lines run across the coalfield from one line to the other.

Behind the coalfield rise the Brecknock Beacons, and an upland slaty country stretches away to the still more ancient promontory of St. David's, which is akin to Braich-y-Pwll and Carnsore Point rather than to the Pembroke and Milford Peninsula. The Teify and Towy take parallel courses over the slaty country to end in Cardigan and Carmarthen Bays.

The climate is, on the whole, insular and rainy. Moorland and hill-pasture cover the interior uplands.

Cardiff stands on flat country on the channel somewhat away from the coalfield. The shorelands correspond to those on the opposite Somersetshire coast. Cardiff has progressed so rapidly of late years as to take the rank of third port in the British Isles. It possesses a University College.

Carmarthen is the capital of its county and the outlet of its pastoral country.

Much iron is smelted in the Merthyr district. Aberdare and Tredegar share the industry. Swansea and Llanelly, on opposite sides of the Gower Peninsula, are the chief centres of copper smelting and tin-plating in the British Isles.

New Milford is the terminus of the G.W.R. main line from Bristol, via the coast towns of Swansea, Llanelly, and Carmarthen. It trades with Waterford and Wexford in the dairy produce of South Ireland required for London markets. Fishguard will soon compete with New Milford.

Milford Haven is the finest harbour on our coasts and is a naval base, but it is too far from centres of population.

Haverfordwest is on the Pembroke coalfield. Tenby is a popular watering place on the Pembroke Peninsula.

XIV.—North Wales and Anglesea.

Approximate Co-ordinates of Bangor: $53\frac{1}{4}^{\circ}$ $4\frac{1}{4}^{\circ}$ W. N.

The northern half of the Principality presents many striking contrasts to the southern half. Coal is absent except in the border county of Flint. The mountain ranges of Snowdon, Cader Idris, and Plinlimmon afford grander scenery than can be obtained in the south. Slate of marketable value is abundant.

Lakes are many, but small compared with those of the similar mountain groups of Helvellyn and Scawfell. Streams radiate to the coast from the neighbourhood of Lake Bala.

The Dee takes a course resembling that of the Severn, but northward and into an estuary silted up with sandbanks. Its course lies through Lake Bala and the beautiful vale of Llangollen, across the Flintshire coalfield at Wrexham, and over the New Red Sandstone Plain to Chester.

The Conway takes a northward course and tumbles over the falls of Bettws-y-Coed on its way to the Irish Sea, just west of Great Ormes Head. A valley to the west of Bettws-y-Coed leads up to the Pass of Llanberis and the Snowdon country. Smaller streams drain from the Cader mountain to Cardigan Bay.

Barmouth is a favourite resort. Dolgelly is the centre for the exploration of Cader Idris. Aberystwith is a university town.

Festiniog, Llanberis, and Bethesda are centres of the slate industry. Portmadoc, Carnarvon, and Bangor are the corresponding ports. The Snowdon range fills the county of Carnarvon and projects southwards into the Irish Sea, terminating in the promontory of Braich-y-Pwll.

The trough of the Menai Strait runs parallel to the mountain axis and divides Anglesey from the mainland. Carnarvon

Castle overlooks the strait; Bangor on the mainland and Beaumaris on the island are linked by the Tubular railway and Suspension (foot) Bridges.

Great Orme is a fine headland of carboniferous limestone standing detached from the coalfield of Flintshire. Llandudno and Colwyn Bay and Rhyl are popular seaside resorts, much frequented by Lancashire folk and holiday-makers from the Midlands.

The Cambrian Railway serves the mountain valleys. The London and North Western main line (for Dublin) follows the coast from Chester to Bangor, crosses the Strait by the Tubular Bridge and then takes the south side of the island to Holyhead, some sixty miles from Dublin. Packet steamers make the journey daily.

The Great Western Railway follows the picturesque valley of the Dee from Ruabon *via* Llangollen to Barmouth.

XV.—The Isle of Man.

Approximate Co-ordinates of Douglas: $54^{\circ}\frac{4\frac{1}{2}^{\circ}}{\text{W.}}$ N.

This island-gem of the Irish Sea rises midway between England and Ireland, Scotland and Wales. It is one mountain wall, except for the sand-spit of the Point of Ayr. Snaefell the culmination. Fig. 153 shows its affinity with the hill-groups of the larger islands. Douglas on the east is the focus of the island's trade and life. Peel on the west has important fisheries. Lead mines occur. But it is as a "playground" for holiday-makers that Manxland has become famous.

SCOTLAND.

I.—The Highland Region.

Average Lat. 57°N., Long. 4°W.

APPROXIMATE CO-ORDINATES OF INVERNESS: $57\frac{1}{2}° \frac{4°\ W.}{}$ N.

THE Highlands and Grampians form two mountain masses in V-form, separated by Glenmore.

Between them lies the Old Red Sandstone Basin of the Moray Firth. On the southern flank is the Old Red Sandstone plain of Strathmore, famous for its fertility. The Highlands culminate in Ben Nevis. They are covered with moorland or hill pasture, have plenty of granite, but few valuable minerals. Cape Wrath terminates the Northern Highlands, Buchan Ness the Eastern Grampians.

Duncansby Head and Tarbet Ness are Old Red Sandstone promontories. The Orkneys are Old Red Sandstone masses detached from the main basin. Skye and Mull are islands of volcanic origin. The rest of the Hebrides, as well as the distant Shetlands, resemble the Highland mass.

The western slopes are exceptionally rainy. The east coast plains are dry and suitable for tillage. The Lochs and Islands of the west enjoy the mildest winter-climate in Scotland.

The eastern slopes have colder winters and warmer summers than the west. The Mull of Cantyre and the Isle of Arran mark the southern limit of the Highland region.

The lochs of the west (*cf.* lough) are more numerous than the firths of the east (*cf.* fiord) because the mountains lie close to the sea.

The chief streams run to the east coast mostly in pairs—the Findhorn and the Spey, the Don and the Dee, the Esks; and the Tay. The valleys of Tay and Spey afford fairly direct access for the Highland Railway from Perth to Inverness.

The East Coast Route follows the lowland sill from Dundee to John O'Groats. Inverness is the chief city of the Highlands, at the gate of the Caledonian Canal.

Thurso and Wick, Fraserboro' and Peterhead are centres of North Sea fishing fleets. Stornoway (in Lewis) and Portree (in Skye) are centres for the western isles.

Oban serves the Western Highlands and Lochs as a tourist centre.

Aberdeen lies at the mouths of the Don and Dee, and shares with Peterhead in the export of granite. It is the seat of a University.

Stonehaven has many valuable quarries in the Old Red Sandstone. Findon cures haddocks.

Perth is the capital of the fertile region of Strathmore.

Dundee and Tayport are the outlets of this region, and also export the sail-cloth, ropes, and linen goods of the Forfarshire mills.

Dundee and Aberdeen supply vessels for the whaling and sealing trade of the Arctic Seas; Aberdeen is developing its herring fishery.

On the west, Iona stands off the shores of Mull; its ruined monastery marks the introduction of Christianity to these northern lands. Staffa is famed for the basalt columns of Fingal's Cave. Ben Lomond and the lake districts of Lochs Katrine and Vennachar, with the lovely country of the Trossachs, lie along the fringe of the Highland country.

II.—The Lowlands.

Average Latitude 56°N. Long. 4°W.

APPROXIMATE CO-ORDINATES OF—

GLASGOW: N. $56°$, W. $4\frac{1}{4}°$ EDINBURGH: N. $56°$, W. $3\frac{1}{4}°$

THIS, the busiest area in Scotland, comprises the parallel depressions of the Forth and Clyde with the coalfields and iron deposits of Fifeshire, Glasgow, Edinburgh and Ayrshire. The Ochil Hills separate it from Strathmore. The Campsie Fells divide the upper Forth from the lower Clyde, and the Pentland Hills lie between the upper Clyde and the estuary of the Forth. All these hills rising out of the lowland plain have a common volcanic origin.

The peninsula of Fifeshire is a prolongation of the Ochil axis.

The Ayrshire Coal Basin looks out on the broad Firth of Clyde and away to the mountains of Arran and Cantyre. Rainfall is medium and slighter in the Forth Basin than in the Clyde. Land under cultivation is the best tilled in the world: oats, rye, barley, green crops and potatoes make the bulk of the produce.

The Forth rises near Ben Lomond and receives the waters of Lochs Katrine and Vennachar some miles below Callendar. It passes the historic town of Stirling, and becomes navigable at Alloa. Thence both banks are lined with towns and served by railways.

Dunfermline, famous for table linen, and Kirkcaldy for linoleum, are situated on the north of the estuary.

Grangemouth, the North Sea port for Glasgow; Boness, the port for the iron town of Falkirk; Granton and Leith, the ports for Edinburgh, lie on the southern side.

A chain of volcanic islands follows the trend of the Firth.

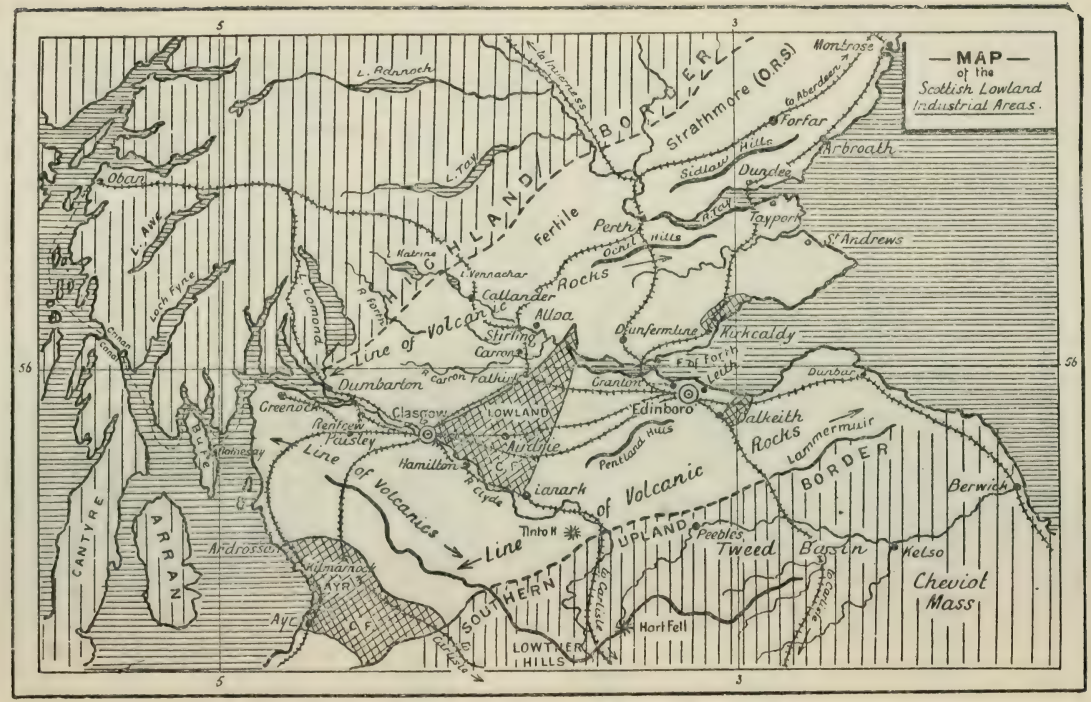


FIG. 198.—THE SUBSIDENCE-TROUGH OF THE SCOTTISH LOWLANDS.

The Forth and Clyde communicate by canal and a network of railways.

The more northerly of the main lines from Edinburgh to Glasgow calls at Falkirk; a middle main line serves Coatbridge, Airdrie and Bathgate; the south line runs through the Clyde coalfield near to Motherwell and Hamilton.

The upper Clyde above Lanark lies among the Lead Hills and gives access to the Lowland Plain for the trunk line from Carlisle.

The main line from Glasgow to the north calls at Stirling.

The busy towns of the Clyde estuary are served by railways on both sides of the river. The northern branch serves Dumbarton and passes forward into the Highland districts of Lomond and Oban. The southern line links Greenock and Paisley with the city of Glasgow. An important line travels via Kilmarnock and the Ayrshire coalfield through the small outlying coalbasin of Sanquhar to Carlisle.

A coast line serves the coal ports of Ayr and Ardrossan.

The southward extension of the Highlands brings within easy access of the workers of Glasgow some of the finest scenery of Scotland; Bute (with Rothesay), Loch Lomond, the sea lochs of Long and Fyne, are all near at hand, whilst the Crinan Canal, crossing a gap in the Cantyre ridge, shortens the route to the Western Isles and Lochs.

III.—The Southern Uplands of Scotland.

Average Latitude, 55½°. Longitude, 3½° W.

The axis of the southern uplands runs S.W. to N.E., parallel to that of the distant Grampians, and to those of the volcanic ranges on the lowland plain.

The culmination is in the Hartfell district, close to the sources of the Clyde, the Tweed, the Yarrow, and the Annan.

To the west lie the Lead Hills and the moors of Galloway. To the east lie the Lowther and Lammermuir ranges. Between these latter and the Cheviot mass runs the Tweed in general parallelism with the axis of the uplands, receiving its tributaries—Yarrow, Ettrick and Teviot—from the south.

The Solway estuary, dividing the Galloway hills from the English Lake group, has a parallel trend in the opposite direction to the Tweed, and receives the south flowing streams of the Annan and the Nith. Three main lines of railway cross the uplands from Carlisle. The westerly one climbs Nithsdale to the Sanquhar coalfield and drops down to the Ayrshire Plain.

The middle route follows Annandale and the valley of the Clyde, whilst the "Waverley" route avails itself of the valleys of Liddell, Teviot and Gala on its way through the tweed-cloth industrial district to Edinburgh.

A fourth line follows the Galloway lowlands to Stranraer and Port Patrick, only 14 miles from the Irish coast and 30 from Belfast.

The southern uplands differ from the Highlands in several ways. They are hills of slate and shale belonging to the same group of strata as the outer ring of our lake district mountains (*e.g.* Skiddaw). Their average altitude is nearly a thousand feet lower, and the rainfall, though considerable in the Hartfell district, is many inches less per year. As a consequence, hill pasture is more abundant than in the Highlands, and sheep are reared in much greater numbers, supplying the wool for the factories of the upper Tweed.

Girvan, on the Ayrshire coast, marks the western limit of the uplands.

Dumfries, the burial place of Burns, only 10 miles from Ecclefechan, the birth-place of Carlyle, is the most considerable town on the Scottish side of the Solway. It is famous for building stone (New Red Sandstone), and stands at the entrance to Nithsdale, whence the railway makes for Ayrshire and the Clyde.

Moffat, standing just away from the Annan-Clyde rail way route to Glasgow and just under Hartfell, is the tourist centre of the uplands.

The Tweed, made famous by the writings and homes of Sir Walter Scott, flows past Peebles and Galashiels, centres of the cloth industry. It calls at Abbotsford, Melrose and Dryburgh in the heart of the "Scott Country," and touching Kelso and Coldstream, empties itself into the North Sea at the border town of Berwick.

Hawick, in Teviotdale, is the chief town engaged in the woollen industry. Yarrow and Ettrick rivers have literary associations with Wordsworth and Hogg.

St. Abbs Head marks the eastern extremity of the upland axis. The East Coast Joint route from London to Inverness skirts the coast from Berwick to Dunbar on its way to Edinburgh.

IRELAND.

I.—The Province of Ulster.

APPROXIMATE CO-ORDINATES OF BELFAST: $54\frac{1}{2}°$ N. $6°$ W.

THE compact, hilly province of Ulster may be looked upon as a south-westward continuation of Scotland. The western mountains of Donegal and the central group of the Sperrin mountains resemble in geological character the Highland mountain axes. The basalt plateau of Antrim corresponds to the volcanic islands of the Inner Hebrides, and the Mourne mountain group is of the Southern Upland (or Lake District) type. The interior of the Province shares the limestone and Old Red Sandstone characters of Strathmore and the Lowland Plain, but, unfortunately, has no coalfields worthy of mention.

Lough Neagh, the largest lake in superficial area in the British Isles occupies the lowest part of the interior.

The drainage is a system of streams, escaping from the inland plain by valleys between the mountain groups.

The Foyle gathers up the streams of the Donegal and Sperrin Heights. The Bann carries off the overflow of Lough Neagh and the tributary-waters of the Antrim Plateau.

The Erne flows over the limestone plain to Donegal Bay. On its way it expands into the lakes of Upper and Lower Erne.

Rainfall is considerable everywhere, but lowest on the limestone plain.

Moorland pastures and quarries are characteristic of wild Donegal. Potatoes, flax and oats are grown in the valleys of Ulster.

The Antrim Plateau is famed for its scenery. Larne and Portrush, at opposite ends of the district, serve as tourist centres. The former is connected by a line of steamers with Stranraer, in Scotland. The latter is close to the Giants Causeway, where the basalt cooled in the characteristic five, six, or seven-sided columns of the causeway.

Fair Head and Malin Head on the north, and Donegal Head on the west are ancient rock-masses, akin to the promontories of the Scottish Highland regions.

Lough Foyle is the drowned valley of the lower Foyle and affords access to ocean-going ships. Belfast Lough, Strangford Lough and Carlingford Lough, around the base of the Mourne Group, offer anchorage to trading vessels and cross-channel passenger boats.

The shores of Lough Neagh, the valley of the Bann, the course of the Newry Canal from Lough Neagh to its seaward outlet in Carlingford Lough, and (more especially) the area around Belfast are the densely peopled parts of the province. Here is the busy area of the Ulster linen industry, introduced from Scotland and still supplied with coal from the Lowland coalfield. Whitehaven, too, is kept busy supplying fuel for Ulster factories.

Belfast, the largest city in Ireland, is the focus of the industry as well as a great shipbuilding centre; it has regular steamship communication with English and Scottish ports. Lisburn, Lurgan and Portadown, around the southern shore of Lough Neagh, Antrim and Ballymena (in a hollow of the basalt plateau) all share with Belfast the linen-weaving and bleaching industries.

Coleraine, at the outlet of the Bann, is famous for its distilleries.

Londonderry, the gate of the Foyle, renowned for its siege

in 1689, forms, with Strabane, Lifford, and Newtown Stewart, a second industrial area.

Atlantic liners from Glasgow make Moville a port of call.

Omagh, at the source of the Foyle, and Armagh, south of Lough Neagh, are episcopal centres.

Donegal and Ballyshannon are fishing centres.

Enniskillen, between the upper and lower lakes of the Erne, is a railway centre and an agricultural town; it communicates with Lough Neagh by canal.

II.—Leinster.

APPROXIMATE CO-ORDINATES OF DUBLIN: $53\frac{1}{2}°$ — $\frac{6\frac{1}{4}°\ W.}{}$ — N.

NEXT in prosperity to Ulster is the eastern province of Leinster, facing the west coast of England and Wales, and communicating with the outer world through Dublin, the capital of Ireland.

The only considerable mountain group is that of the Wicklows, immediately south of Dublin. Built of granite and other igneous materials, they are famed for their scenery, and give to the coast from Dublin to Wicklow a fine series of cliffs.

The rest of the province belongs to the central limestone plain.

The rivers of the northern portion drain eastward to the Irish Sea. The Boyne and the Liffey are the only streams worthy of mention.

The remaining streams drain southward to the harbours of Wexford and Waterford, the two chief outlets of agricultural industry for the south of Ireland.

The Slaney, like the Liffey, rises in the Wicklow group. The Barrow, the Nore, and the Suir converge on the Waterford

Harbour from radial valleys on the interior plain. The ridges between them carry small patches of inferior coal.

Howth Head, which guards the north of Dublin Bay, is a limestone promontory akin to Great Ormes Head, thrust out from the central plain. Wicklow Head is a mass of slate, similar to that of Braich-y-Pwll, whilst Carnsore Point, the south-east extremity of the province and of Ireland, is an igneous headland corresponding to St. David's on the opposite shore of Wales.

The Wicklows receive more rain than the lowland interior.

Dublin and Drogheda, on the coastal strip between the Mourne and Wicklow groups, lie in the driest region on the island. The summer temperature of this province is the hottest in Ireland.

The country around Dublin is the busiest in the province. Immediately west and north of this lies the thinly peopled district of the Bog of Allen, and to the south stand the still more sparsely populated heights of Wicklow.

Agriculture in the form of dairy-farming forms the staple occupation of the province, and finds outlets in the ports of Wexford and Waterford, which trade largely with the Bristol Channel towns.

The north border county of Louth shares in the trade and shipping of Carlingford Lough and Newry Canal. Greenore is a growing port. Drogheda is the outlet of the valley of the Boyne. Balbriggan is a linen and cotton-hosiery manufacturing town. Kingston the outport of Dublin, is but 60 miles from Holyhead, the packet station of the English London and North Western Railway.

Bray and Wicklow are seaside resorts much used by Dublin residents.

The capital is the centre of the poplin and linen weaving industries; it contains many breweries and distilleries; it can boast of two cathedrals and two universities; railways and canals connect it with all the important towns in the island.

The main line to Ulster follows the coast towns to Dundalk, and then proceeds by way of the line of the Newry Canal and the eastern side of Lough Neagh to Belfast and Derry. The main line to Connaught strikes across the inland plain through the agricultural centres of Athlone and Ballinasloe to Galway and the tourist centres of Connemara.

A third trunk line strikes south-west, via Maryborough and Mallow Junction, for Cork and the Killarney country; it throws off branches along the valleys of the Slaney, Barrow, Nore and Suir, to the ports of Waterford and Wexford. A coast line passes Bray and Wicklow on its way to Wexford Harbour.

The Royal Canal and the Grand Canal traverse the central plain and link Dublin with the Shannon, the former near Longford and the latter near Ballinasloe.

A branch from the Grand Canal joins the head waters of the Barrow at Athy.

Kilkenny on the Nore, Athy on the Barrow, and Enniscorthy on the Slaney, export their produce from the harbours of Waterford and Wexford. Rosslare Harbour is the new packet station for Waterford.

Waterford and the towns on the Suir fall within the province of Munster, which we shall consider in the next section.

III.—The Provinces of Munster and Connaught.

APPROXIMATE CO-ORDINATES OF—

GALWAY: $53\frac{1}{4}°$ N., $9°$ W.

CORK: $52°$ N., $8\frac{1}{2}°$ W.

THESE provinces recall, by their irregular coast line and numerous rocky islets and stacks, the west coast of Scotland and the more distant fiords of Norway. They belong, however, to two distinct geological formations.

The lake district of Connaught is a southern extension, and marks the limit of the Highland Axis through Donegal.

The mountains of Kerry and the promontories of Munster are folded grits and purple slates of Old Red Sandstone age and character. Killarney lies in a trough of limestone shut in by these slaty hills.

The portion of the limestone plain between the Connemara Lake group and the river Shannon, with its expansions of Allen, Ree and Derg, belongs to Connaught and is the gathering ground of many streams.

The Shannon strikingly recalls the Severn in the general direction of its flow, and in the fact that the majority of its tributaries come from the uplands on the west.

The Connemara country compares with the Snowdon region. The estuary of the Shannon has coalfields on either side (though poor in quality), offering another point of similarity to the Bristol Channel.

Limerick occupies an analogous position to Bristol, and Galway to Aberystwyth.

The folds of the grits and slates of the mountains of Kerry and Cork have given rise to a remarkable parallelism in the river systems of Munster.

The Blackwater, the Lee and the Bandon flow due east in their upper courses and then escape at right angles—through gaps in the folds—due south to the open sea at Youghal, Queenstown and Kinsale. On the west of the culmination in Macgillicuddys Reeks, the drowned valleys of Dingle, Kenmare, and Bantry Bays exhibit a similar parallel arrangement.

The Silvermine uplift, west of Limerick, is akin to the Mourne and Wicklow groups. The rain winds from the south-west deposit copious showers on the coast mountains of both Connaught and Munster; the Reeks of Kerry occupy the wettest district in Ireland; Munster and Connaught have the most insular climate in the British Isles, being most open to

oceanic influence from the direction of the warm moist winds of the Atlantic.

The range of temperature between summer and winter in Kerry is only 15½° F., whilst that of London is 25½°. Summer is 5° cooler and winter is 5° warmer than in the Thames basin.

The climate is too moist for crops; rich emerald pastures cover the valleys, moor and hill-pasture the uplands; the latter especially in Connemara and Kerry. Population, nowhere dense, is thinnest in the same districts.

Sligo, Ballina and Westport are outlets for the valleys of northern Connaught and send boats to the mackerel fisheries of the Atlantic coast.

Galway is the capital of Connaught and the gate for tourists to the wild country of Connemara.

Ballinasloe, on the trunk line from Dublin to the west, is the centre of agricultural exchange on the Connaught Plain.

Killaloe is the Connaught outlet on the Shannon.

Limerick is the centre of industry for the northern half of Munster. It is the chief town on the Shannon and a busy market for leather, bacon, dairy-produce, paper and tobacco.

The Great South and Western line passes Tipperary on its way to Cork, the capital city of Munster. At Mallow a line is given off to Killarney and another branch follows the valley of the Blackwater to Waterford.

Limerick is connected with Waterford by rail through the basin of the Suir, past Clonmel and Carrick.

Tralee and Bantry are fishing centres on the western bays.

Valentia island is but 1,800 miles from St. John's, to which it is joined by numerous Atlantic cables.

Berehaven has been adopted as a naval station.

Exercise.—By means of dividers and scale given on any good map of the British Isles, find distances not given in Fig. 199, and insert. Also find distances to nearest continental ports.

FIG. 199.—CENTRES OF POPULATION

Typical Exercises on the Maps.

(1) Find the area of Wales by the aid of squared paper ($\frac{1}{10}$ in. squares).

(2) Mark on the map of England the 100-fathom line and the 500-feet contour line.

(3) Draw a section, by aid of a contoured map, (*a*) across the Pennines from Liverpool to Hull; (*b*) across the Grampians from Fort William to Stirling.

(4) On a map of Ireland mark the rainiest areas by shading, and explain their location.

(5) Draw a full sketch-map of (*a*) the woollen district of Yorkshire; (*b*) the cotton centres of Lancashire; (*c*) the Manchester Ship Canal; (*d*) the Potteries; (*e*) the Tyne and Wear; (*f*) the Staffordshire coalfields.

(6) How would you get from Liverpool to Glasgow, Newcastle, Oxford, Dover; from Sheffield to the Channel Islands, Antwerp, the Baltic, Canada, the Cape, Japan?

(7) Draw a map of England between Lats. 53° and 54° N., of Scotland between 55° and 57° N., of the Irish Sea between 53° and 55° N.

(8) Analyse the position and account for the importance of Bristol, Southampton, Leeds, Dublin, Carlisle, Norwich.

GEOGRAPHY OF EUROPE.

PART I.

GENERAL CONSIDERATIONS.

CHAPTER I.

World Position, Dimensions, Broad Outlines of Physical Features and Geological Structure.

[Maps to be used: Terrestrial Globe; Mercator's Map of the World; Europe (orographical), and Europe (geological).]

THE Old World forms the largest land-mass on the globe. Physically, it is divided into two continental masses, **Eurasia**, whose long axis extends east and west; and **Africa**, whose long axis runs north and south. Eurasia is feebly divided into two very unequal continents, *Asia* and *Europe*, by the minor axis of the Ural Mountains. The area of the Old World may be taken roughly as 33 million square miles. Of this area $\frac{17}{33}$, or more than half of the whole, is included in Asia and $\frac{12}{33}$ in Africa.

Europe covers only $\frac{4}{33}$, or about $\frac{1}{8}$ of the whole. Least among the continents, it ranks first in importance,

Three Great Belts.—The Old World may be divided conveniently into three great belts by two lines running

(*a*) From Morocco to Behring Strait;

(*b*) From Sierra Leone to Vladivostock.

The *Northern Belt* would include the whole of Europe and

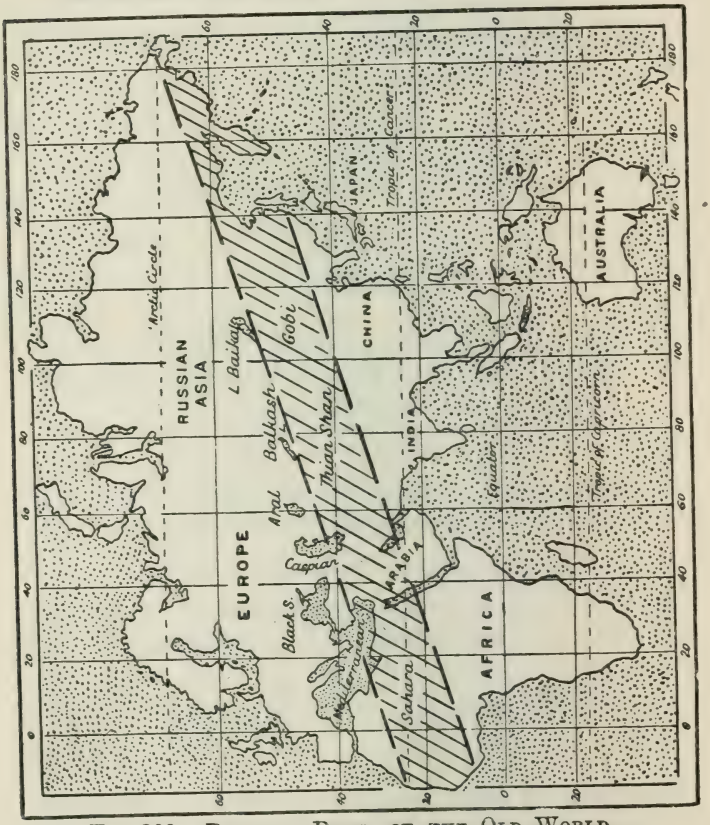


FIG. 200.—PHYSICAL BELTS OF THE OLD WORLD.

that part of Asia which is under the rule of a European power, as well as a physical continuation of the European plain.

The *Middle Belt* would include the great deserts and plateaux of the Old World.

Between the two runs the remarkable belt of depressions filled by lakes and inland seas.

The *Southern Belt* would include tropical and peninsular Africa, together with the densely peopled peninsulas of Southern Asia, the plains of China, and the archipelagos of Japan and the East Indies.

Africa nowhere transgresses more than twelve or thirteen degrees beyond the Tropics.

Apart from China and Japan, a large part of the temperate zone in *Asia* is occupied by lofty, bare, rainless plateaux.

The average elevation of the continent of *Europe* is considerably less than that of Asia or of Africa, and hence the temperature on the plains is distinctly higher than that of similar latitudes in Asia. Thus, on the whole, the temperature belts of Eurasia run diagonally to the physical belts, as follows :—

Arctic Belt : north of a line from Archangel to Vladivostock.

Temperate Belt : comprising the great plains of Europe and the wheat-lands crossed by the Trans-Siberian Railway.

Mediterranean Belt : extending to China, but considerably modified on the Asiatic uplands.

Tropic Belt : lying nowhere over Europe,

In each case the climatic conditions over Asia are more continental in type than those over Europe, and the tropical belt, as stated, nowhere lies over Europe.

Europe's Open Coast-Line.– One more consideration deserves notice. In the important matter of open coast line, and interior access by means of inland seas, Europe possesses an immense advantage over her neighbour-continents of the Old World. Both Asia and Africa are deficient in inland seas. Africa is poor in harbours ; well nigh $\frac{1}{3}$ of Asia's coast line falls within the zone of Arctic climate just defined.

Comparative Population of Europe.—If we take the population of the three continents as 15 hundred millions, Europe has $\frac{4\frac{1}{2}}{15}$ of the whole, Africa only $\frac{1\frac{1}{2}}{15}$ of the whole,

and Asia has $\frac{9\frac{1}{2}}{15}$, or rather more than half of the whole. If we tabulate in the form of $\frac{\text{people: in millions}}{\text{area: in million sq. mls.}}$ we get the following comparison:—

Europe: $\frac{450}{4}$ =112 per sq. m.

Asia: $\frac{950}{17}$ =55 per sq. m.

Africa: $\frac{150}{12}$ =14 per sq. m.

Old World: $\frac{1550}{33}$ **=47 per sq. m.**

PHYSICAL AND GEOLOGICAL STRUCTURE.*—An orographical map of Europe reveals the presence of mountain highlands along the Atlantic rim, and a curved inland series of mountain chains with a general East-West trend. The former are among the oldest portions of the continent. After exposure to the Atlantic waves and to denudation since early geological times they present to the open ocean a scarred surface, and a much-indented coast-line. The backbone of Scandinavia, the highlands of Scotland, the ancient peninsula of Brittany and the Finisterre corner of the Spanish peninsula belong to this system.

The Geologically Recent Mountains.—On the other hand the Pyrenees, Alps, Appennines, Carpathians and Caucasus ranges form part of a grand series of comparatively recently elevated mountain-chains of great altitude. These have suffered much less from denudation than the older mountains of the Atlantic rim, since they did not attain their maximum elevation until Tertiary times. Peaks therefore predominate rather than domes. They expose everywhere a core of ancient rocks, and are flanked by rocks of descending geological age, which form the hilly forelands of the main chain, down to rocks of the most recent series, which fill the valleys and basins enclosed within the curves of the chains.

* See Appendix on "The Bearing of Geology upon Geography."

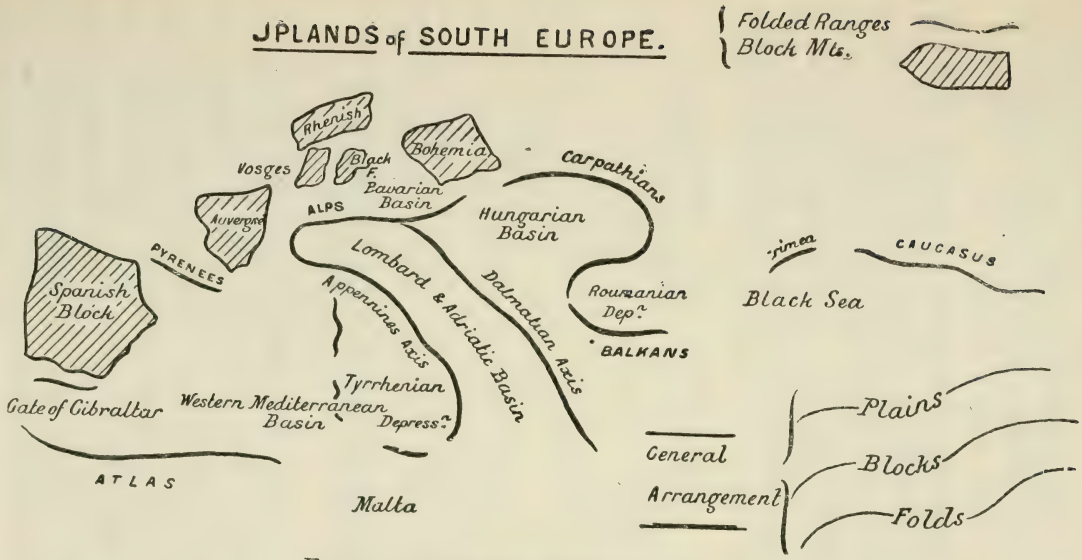


FIG. 201.—UPLANDS OF SOUTH EUROPE.

The crumpling of strata consequent on the folding and uplifting of these mountain chains attains a maximum in the Swiss Alps. Within the curves of these ranges the land has sunk, in some cases even below sea-level.

Crust-Blocks.—Along the northern edge of the Swiss chains we find upland country of a different character. Plateaux of the crust-block type prevail, more or less polygonal in form, and bounded by fault-planes. The country around them has subsided and, by fracture, has left these outstanding masses. Subsidence within the mass itself has in some cases resulted in a basin within a plateau, as, for example, in the Prague basin

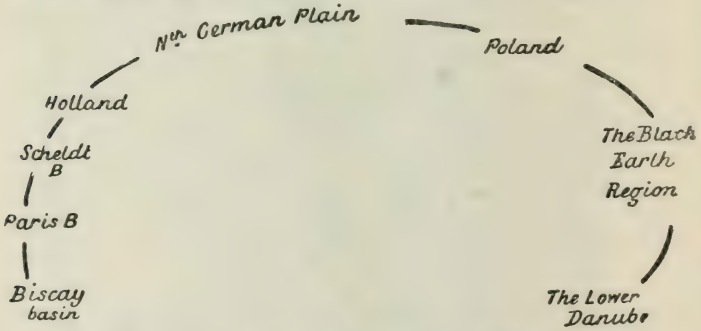


FIG. 202.—RING OF PLAINS ENCIRCLING THE UPLANDS OF SOUTH EUROPE.

of the Bohemian plateau and in the Autun basin of the Auvergne block of Central France. To this type of country belong the Spanish tableland or "meseta," the Auvergne plateau of France, the "horsts" or saddles of the Vosges and Black Forest, and the mountain-walled basin of Bohemia. The mass is in each case a block of ancient crystalline rocks. The basins are often filled in with a series of sediments, and outside the mass Secondary, or even Tertiary and Recent rocks, lie contiguous with the ancient mass, the more recent where the subsidence has been greatest, the more ancient where the subsidence has

been less. Coal and iron occur in the basins and the valuable minerals are often found in the mountain rims, *e.g.*, Asturias of Spain, St. Etienne district of France, the Riesen and Erz boundaries of Bohemia. (*See* Fig. 211.)

The Walds of Germany.—Projecting still further north upon the great Plain of Europe is the upland country of the German Walds (*Cf.* English Wolds)—the district of High Germany as contrasted with the Low German plain. This picturesque region is bordered by the Belgian Ardennes, the German Jura, and the Harz Axis, whereas on the east it abuts against the Bohemian plateaux.

The Great European Plain.—Encircling these rings of upland runs the Great European Plain, split up into shallow basins by gentle *up*-swellings of the contour. These shallow basins open out to the Atlantic or to one or other of the numerous inland seas which are so characteristic a feature of European Geography. (*See* Fig. 202).

While the uplands of the continent are (as in the British Isles) chiefly ancient rocks flanked by forelands of Secondary strata, the basins of the great plain and those within the curves of the great mountain chains are mainly filled by Tertiary and Recent sediments resting on a floor of limestone equivalent in age to our English chalk. They, therefore, present many resemblances to our London and Fen basins. The Great Plain of Russia divided, though not impassably, from the even larger plain of Asiatic Russia by the Ural Axis (running north and south, and forming the convenient eastern limit of Europe) culminates in the low hills of the Valdai, no higher than our Cotswolds, and thence slopes away to the sea-filled depressions of the Baltic, the White Sea, the Black Sea, and the Caspian. The whole plain is covered by strata practically horizontal. Finland is the oldest portion of the plain, and belongs, physically and ethnologically, to Scandinavia rather than to Russia. Crossing the plain from the Valdai

FIG. 203.—RELATION OF PLAINS TO UPLANDS IN EUROPE.

southward to the Crimean and Caucasian barrier, we traverse the Primary, Secondary and Tertiary strata in turn. In the valleys opening out to the Black Sea denudation has laid bare older rocks, even down to the crystalline floor beneath all sediments.

Two Lines of Depressions.—We have already noticed the fact of Europe's numerous inland seas. A bathy-orographical map (showing depths and heights) of Europe reveals *two lines* of depressions, one *north* of the mountain axis of the continent and the other to the *south* of it. Their general trend is again in parallelism with that of the uplands.

(*a*) The Northern Group of Depressions.—This includes the open North Sea, the channels of the Skagerack and Cattegat, the Baltic, the great fresh-water lakes of Finnish Russia and the White Sea. It is also worthy of note that the trough of Skagerack is continued across Sweden by way of Lakes Wener, Wetter and Maelar in direct line toward the Gulf of Finland. A line of recent deposits links these water-filled depressions all the way from the Skagerack to the White Sea and points to the once continuous nature of the trough. The North Sea is salt. The Baltic is much less salt, since river-inflow exceeds evaporation, and the movement of water is therefore outward. The great lakes, having outlets, are fresh in character, and present analogies with those of the North American Continent. The belt lies in cold, temperate latitudes, and the freshness of the Baltic waters combines with winter conditions of climate to lead to the closing of Baltic harbours by ice for a considerable part of the year, varying, of course, with latitude. The seas and lakes are all comparatively shallow.

(*b*) The Southern Group.—On the other hand, the Southern Group, including the three depressions, each more than 6,000 feet deep, of the Mediterranean basin (as well as its branches of the Adriatic and Ægean seas), the Euxine and the Caspian

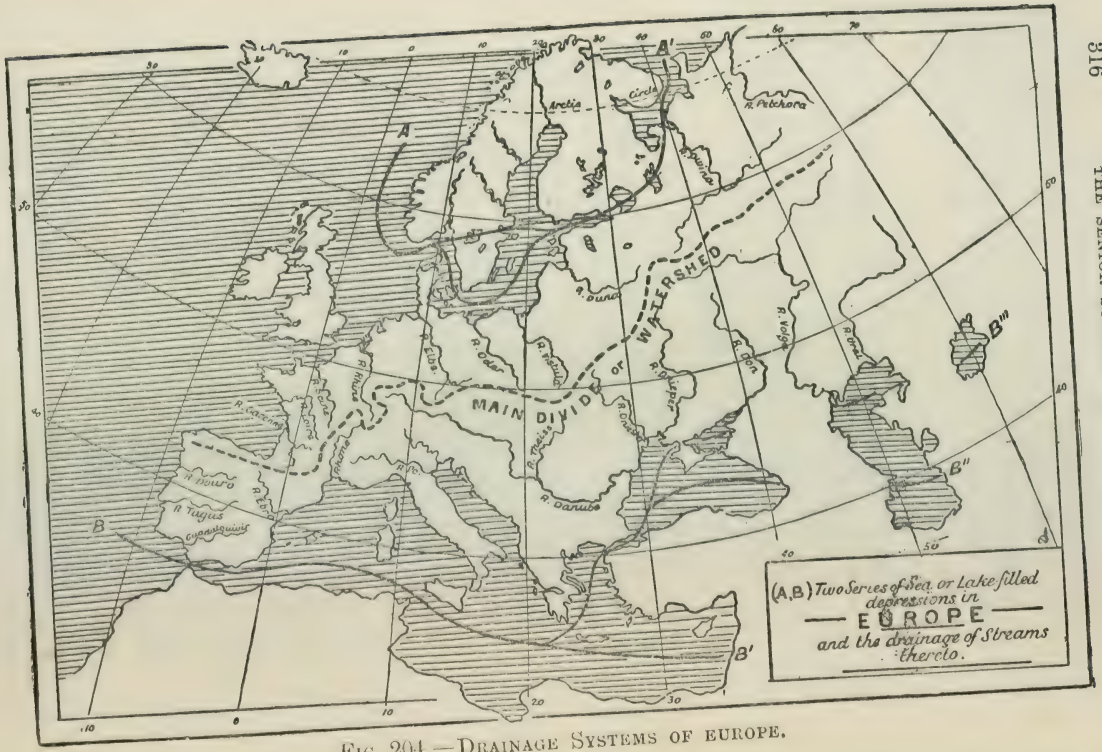


FIG. 204.—DRAINAGE SYSTEMS OF EUROPE.

are deep and salt. Their saltness is due to evaporation exceeding river-inflow. What current there is through Gibraltar Straits must be an inflow from the Atlantic, and therefore of a salt nature.

The Mediterranean, from whatever standpoint we consider it, is the most important inland sea in the world.

The Black Sea, lying in colder latitudes than the Mediterranean, is less salt from the fact that the inflow is greater and evaporation is less. Hence its tendency to freeze.

The Caspian suffers such extensive evaporation that its waters are excessively salt for so large a basin, and moreover its level has been reduced to 85 feet below sea level.

Ribbon Lakes.—Ribbon-lakes corresponding to those of our Scottish Highlands occur in the upper valleys of the Scandinavian Axis. Both flanks of the Alps offer many lakes similar in character to our English lakes, but on a grander scale and proportionate with Alpine altitudes.

Chains of Islands.—The Baltic and the Mediterranean have each a chain of islands. The westward submarine extension of the European plain supports the British Archipelago. The distant volcanic plateau of Iceland is joined with Greenland on the west and Europe on the east by the hidden Wyville Thomson plateau, which divides the Atlantic trough from the Arctic ocean-basin.

CHAPTER II.

Climatic Variations over the Continent of Europe, with their Effect on the Vegetation and Agriculture of Different Areas.

[Maps to be studied: Orographical Map of Europe; Isothermal Maps of Europe; Rainfall Map; Map Showing Zones of Vegetation and Map Showing Vegetable Products.]

SINCE Europe is the smallest of the three continents of the Old World, it can offer least variety of climates over its area; but, being a continent, with its western border fringing an ocean, and its eastern border turned towards the greatest of the continents, and, moreover, extending through 35° of latitude, it presents a much greater variety than is experienced in any one country, like Britain, France or Germany.

Varieties of European Climate.—To have grasped the causes which underlie the varieties of British climate, and to be familiar with those varieties, is to have gone far to get a clear idea of the variation of climate over the continent. There is a change as we travel eastward from the *equable* climate of the sea-board countries to the interior Great Plain of Russia, which, especially in the south-east, affords the nearest approach to the extreme *continental* type of climate. On whatever line of latitude we travel eastward this change from

insular to continental—from equable to extreme—is noticeable. To travel northward along any line of longitude does not necessarily involve such a change of type. The only change would, generally speaking, be one of mean annual temperature, such mean temperature falling as we journeyed northward towards Arctic latitudes. Increase in altitude, as on a mountain range, or the occurrence of a large sheet of water, such as an inland sea, would effect a variation from these general conditions.

Rain-Bearing Winds.—It is made clear in text-books of physiography (and in Part I. of this Volume) that isotherms and rainfall are affected largely by the general arrangement of the uplands with regard to the rain-bearing winds which blow in from the ocean. In Europe the average direction of such winds is from the *west* for Mediterranean countries, and from the *south-west* for the British Isles, the North Sea countries, and Scandinavia.

How Mountains affect Rainfall.—Mountain ranges with their axes at right angles to the direction of the wind, intercept it, divert it upwards, and lead to a fall of rain from condensation in the upper cold and rarefied layers of the atmosphere. The

FIG. 205.—MOUNTAINS AFFECTING RAINFALL.

greater the altitude of the barrier, the greater the probabilities of condensation, with rainfall or snow. Mountains exercising such an influence as this in Europe are: The Highland Axis of Scotland, the Mountains of Kerry, the Pennine "backbone"

of England, the Dovrefjeld of Norway and the low Brittany Axis of France. These are areas of heavy rainfall. Further south, and opposing the progress of the westerly winds, we have the very rainy west-facing slopes of the Finisterre region of Spain, the Pyrenees, the high Alps and the long Dalmatian Axis forming the eastern slope of the Adriatic basin.

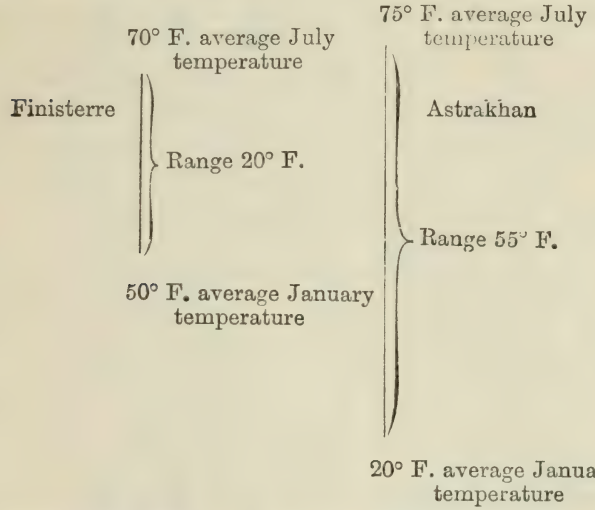
Decreased Rainfall in the Interior.—The countries of the great plain afford no opposition to the progress of these moisture-laden winds. Hence, travelling towards the interior, the rainfall decreases practically by the law of distance from the ocean. The uprising of any range of hills in the track of the rain winds has the general effect of increasing the rainfall locally.

"Rain Shadow."—It is worth noting that the landward slope of a rainy mountain axis often presents unusually dry climatic features. Some writers describe this by the very convenient term of "rain-shadow." Such areas are noticeable behind the Finisterre country, in North Sweden, over the Appennines from Naples, and on the Caspian Slope of the Caucasus. We have indicated the wettest regions. Generally speaking, the coasts and the uplands are rainy; rain increasing with average altitude in every case. The driest regions are either in "rain-shadow" areas, or in the low, open interior, far removed from oceanic influences. North Sweden, Finland, East and South Russia, and the Spanish tableland are the dry climatic areas of Europe.

Rainfall and Temperature.—A study of the summer and winter isotherms of Europe will make it clear that regions of heavy rainfall experience smaller annual ranges of temperature than do dry districts. Taking extreme cases, Finisterre and Astrakhan, we find the range is 20° F. in the former and 55° F. in the latter place.

Finisterre experiences an equable climate, with only small variation between summer and winter, and no excess of heat

for its latitude (8° south of Astrakhan), whereas Astrakhan experiences considerable heat in summer (5° F. hotter than



Finisterre and 10° F. above Nantes, which lies in the same latitude as Astrakhan).

Summer Isotherms Influenced by Altitude.—The July isotherms cross Europe in a general easterly direction. This indicates that the temperature falls as we travel northward, a result in accordance with what we should naturally expect. But two remarkable digressions from this general direction are worthy of special notice. The 70° F. isotherm might almost serve as a boundary between the mountain lands of South Europe and the open plain of Central Europe. The 60° F. isotherm shows even more remarkable vagaries, by looping around the Baltic depression. The former points to uplands being warmer than latitude alone would warrant in the summer; the latter indicates the increased warmth of a "rain shadow" area under a summer sun—the Norwegian Slope having an average temperature below 60° F., though the rain shadow area in the same latitude has a temperature above 60° F.

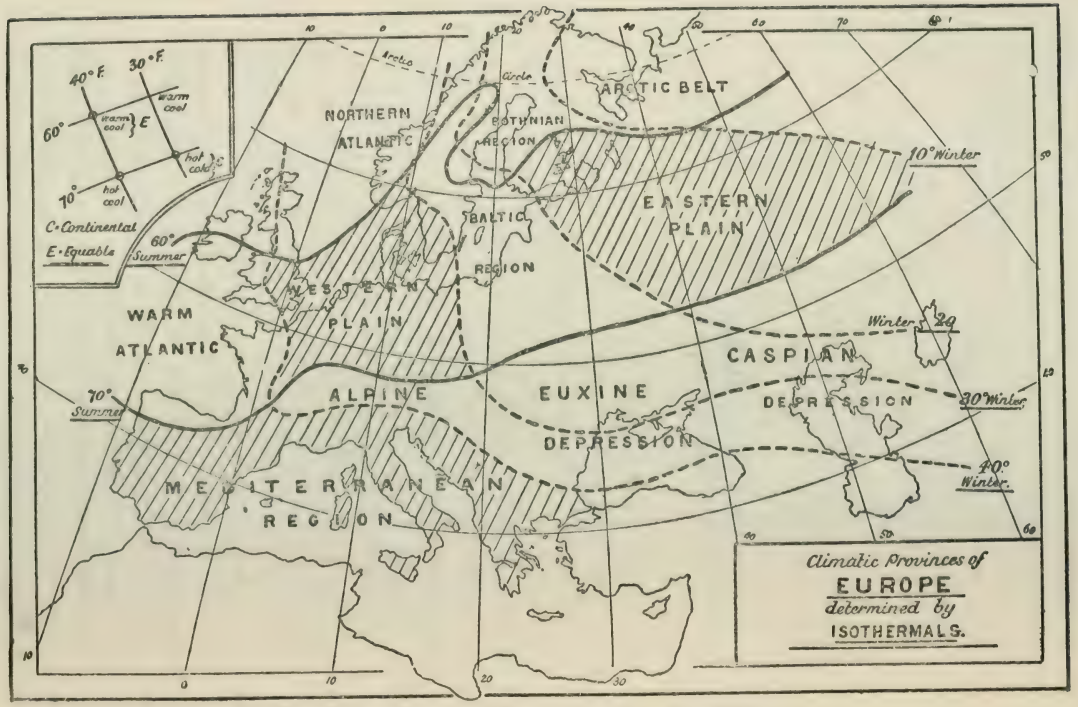


FIG. 206.—CLIMATIC PROVINCES AND ISOTHERMALS.

Winter Isotherms.—But when we come to the winter isotherms, we find that, though they reveal a distinct parallelism to one another—neglecting local variations—they show a distinct unconformity to lines of latitude. Their average direction on the continent is from N.W. to S.E., which means that the most rapid fall of temperature would not be experienced by travelling toward the Pole, but by taking a N.E. direction toward Spitzbergen.

It will be seen (and to this we have given special attention in Part II. of this volume) that the divergence from parallelism with latitude lines is greatest in the British Isles. Norway and Finisterre furnish other examples. Zones of *winter* climate in these exceptional cases are East and West, not North and South—colder to the east, warmer to the west.

Influence of Sea on Climate.—A map showing *mean annual ranges* of temperature over different districts of Europe shows the influence of the neighbouring ocean in producing equable conditions of climate (Scandinavia, British Isles, Brittany, Portugal). The Basin of the Volga, remote from the ocean, affords the nearest approach to a continental climate. Western Russia and the plains of the Baltic Basin experience a medium range. Holland, Belgium and North France are more equable but cool; South France, Spain, Italy and Greece are fairly equable, and warm.

Climatic Provinces.—It is, therefore, no difficult matter to divide Europe roughly into climatic provinces, each having its own distinctive type of climate, and its consequent agriculture, whether of lowland plain or upland slope. Figs. 206 and 207 attempt such a division. Details of each area are given below.

The Caspian Depression.—This represents Europe's nearest approach to desert conditions. The steppe-lands of this

FIG. 207.—BROAD CLIMATIC UNITS.

region, comparable in climate, though scarcely in fertility, to the prairie lands of Canada between Winnipeg and the Rockies, support numerous herds of Khirghiz sheep, reared for their wool and tallow. The salt-impregnated shores of this inland salt sea (whose surface, owing to evaporation, is 85 feet below sea level) contrast with the virgin-lands of Western Canada but are easily compared with the Salt Lake depression on the Rocky Mountain tableland of the Western States of the Union.

The Euxine Depression.—Here there are less extreme conditions of summer heat and winter cold. Moreover, its "black earth" is remarkable for its fertility, and now the grasslands have been converted largely into wheat fields.

The Baltic Basin.—This area is best divided into two climatic regions. The line of depression, traversing the Skagerack, Lakes Wener, Wetter and Maelar, the Gulf of Finland and the great Lakes of North Russia, serves as a convenient line of demarcation. The northern or Bothnian area has a colder and more continental type of climate, lying as it does on the rain-shadow side of the Scandinavian Axis. It is an afforested region, and yields valuable supplies of birch and coniferous wood (Scotch fir, &c.), the export of which forms one of the chief industries of the North Baltic.

The southern half of the depression, that of the Baltic proper, includes the warmer and more equable areas of Poland, the North German Plain, Holland, the peninsula and islands of Denmark and the fertile region of South Sweden. The climate is moderated by Atlantic influences in the shape of warm oceanic drift and cyclonic air-circulation which penetrate this region *viâ* the North Sea, and *over* the British Isles respectively. Here, whilst much timber is available on the hill slopes (especially oak, beech, and spruce fir), the lowlands which form so great a part of the whole area have been cleared for tillage. Wheat and rye are abundantly grown. Flax, hemp and jute thrive. Potatoes and the sugar beet are

extensively cultivated; the less fertile lake regions between Berlin and Riga support many geese-farms. Potatoes are much used in the distillation of brandy. The sugar beet has ousted the demand for the products of the tropical sugar-cane.

THE WHITE SEA BASIN.—This is the only Arctic area on the European Continent. It is the home of moss and lichen and dreary tundras; the Lapp, with his reindeer and dogs, subsists on the sale of furs, and on whaling.

DENMARK AND HOLLAND.—These countries lie too low, and are too near the ocean to have the dry soil and low rainfall suitable for cereal growing. They are given up rather to dairy farming, and are the principal butter and cheese-exporting countries on the continent.

CENTRAL EUROPE.—North of the physical and climatic barrier of the Alps lie the Paris Basin, South (or High) Germany, and Bohemia. They have common character-

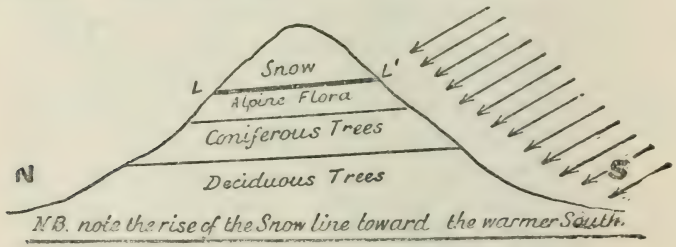


FIG. 208.—VEGETATION ZONES ON THE ALPS.

istics, though, of course, the equable gives place to a more extreme type as we travel towards the interior. They mark the northern limit of the vine, which thrives chiefly on the southward-facing slopes of these countries. The Alps themselves present a striking illustration of the variation of vegetation, with altitude as well as with latitude, from the characteristic vegetation of the lowlands, whether on the

north side or the south side, right up to the moss and lichen zone which merges in the snow line.

Mediterranean Region.—To the south of the great mountain barrier of the Pyrenees, Alps, Carpathians and Balkans, we have the Mediterranean region, with its characteristic flora and fauna. Sheltered on the north and east, open to moist influences from the Atlantic, and *periodically* to hot, parching winds from the Sahara (*e.g.*, the sirocco), it presents a striking contrast to the characteristic temperate-zone features of climate and agriculture which are common to Europe north of the Alps.

The Biscay basin of France and the ocean-facing valleys of Portugal, benefiting by the genial influences of Atlantic circulation, belong in character to this region. The vine thrives; oranges, lemons, pomegranates, bananas, olives and tobacco are found here, and only here in Europe. Even rice and cotton are grown on the coastal plains and deltas. Roses grow in great profusion.

Two areas of great fertility presenting considerable contrast are the basin of the Po and the plain of Hungary. They lie encircled by the great curves of the Alps and Carpathians respectively. Their mean annual temperature is thereby heightened. Rice and the olive are characteristic of the warmer plain of Lombardy. Wheat and wine are the chief productions of the Hungarian plain, with its alluvial and volcanic soils. Beech-trees give their name to a whole province (Bukowina) in the south-east corner of the basin.

Norwegian Slope.—The steep slope of Norway, from the snow-clad, glacier-bearing uplands of the Kiolen axis to the much-indented Atlantic coast, shares with the Western Highlands of Scotland in a general lack of trees, a poor quality of hill pasture, and consequently an absence of agricultural development. Heavy rains and rocky slopes are against tillage farms.

Europe and North America.—Having now reviewed the climatic and agricultural features of Europe it is interesting to make a few comparisons with North America. These all point to more favourable conditions of climate in Europe than in America east of the Rockies. The climate of the Baltic is

FIG. 209.—JULY TEMPERATURE BELT.

comparable with that of the great lakes rather than with that of the Hudson Bay—in the same latitudes. Indeed, the Hudson depression can be compared only with the White Sea region of Europe. The wheat and grass lands of the Dominion experience a similar climate to the wheat and wool districts of

FIG. 210.—JANUARY TEMPERATURE BELT.

South Russia. The Atlantic seaboard of Europe is only comparable with the Pacific seaboard of America, *i.e.*, the west coast in each case (influenced by ocean currents). The Southern States of the Union correspond to the Mediterranean type.

Wheat can be grown on the average 10° further north in Europe than in Canada. Rye and oats will ripen even within the Arctic Circle along the Norwegian coastlands. Maize, confined to the Mediterranean region of Europe, is much more important in the States. Tobacco, and cotton, too, are cultivated to a much larger extent since the shores of the Gulf of Mexico are much wetter than the coastal plains of the Mediterranean.

The mass of Europe, and the whole of Canada, lie north of the mid-line 45° N. latitude; the great bulk of the States lie south of this line. Hence all comparisons of climate should be made between Canada and Europe. The student's general familiarity with conditions of climate prevailing, on the one hand over the continent of Europe, and on the other hand over the Dominion of Canada, will serve to emphasise the comparisons in favour of Europe made in this chapter.

Table of Climatic Units.—In the following table, the continent of Europe is divided into climatic units. It will serve as a valuable exercise for the student if he will fill in the details and so discover the distinctive features of each area. The units have been arranged in groups to bring out similarities. The effect of climate and soil on the class of agriculture will be brought out in the completed table. The study of the table should lead the student to arrive at

GENERAL PRINCIPLES, *e.g.*:—

Cold and infertility increase with altitude.

A large range of temperature—*i.e.*, a climate of extremes—occurs in regions of low rainfall.

Cereals thrive on fairly dry plains.

Vegetable-farms arise on moister plains and slopes.

Cattle are reared on the rich damp meadow lowlands.

Sheep and goats can be profitably kept on the poorer hill-pastures and on the pusstas and steppes of the dry areas.

District.	Climatic Data.					Agriculture.				Density of Population.
	Summer t°.	Winter t°.	Range of t°.	Rainfall.	Elevation.	Nature of Soil.	Crops.	Cattle.	Sheep.	
The Caspian Depression										
The Euxine Depression										
Mid Russia										
Baltic Germany										
Holland and Denmark										
Bothnian Basin										
White Sea Depression										
Belgium										
The Paris Basin										
The Biscay Basin										
Uplands of Central Europe.										
The German Highlands										
The Alps										
Bohemia										
Sheltered Basins.										
Rhone Basin										
Lombard Plain										
Hungary										
Danubian States										
Mediterranean Region.										
Iberian Peninsula										
Italian Peninsula										
Balkan Peninsula										
The Atlantic Border.										
The Norwegian Slope										
Brittany										
Portugal										

CHAPTER III.

The Mineral Wealth and Industrial Development of Europe.

[Maps to be studied: Geological, Mineral, Industrial and Population Maps of Europe.]

As we noticed in our study of the British Isles, the mineral wealth of a country is confined chiefly to the Primary rocks. Iron-ores of medium quality, copper-bearing slates, salt, and good building-stones occur in the Secondary rocks; but the Tertiary rocks are scarcely consolidated and are marked by a striking absence of useful minerals.

The Useful Metals.—Apart from iron and copper, the ores of the useful metals occur in veins and in irregular masses associated with the ancient crystalline masses of Primary age. The principal veins and masses occur along the fractured rims of these crystalline areas, rather than in the heart of the masses themselves. Now the folded mountains have a crystalline core, but on the whole they are very poor in mineral wealth compared with the faulted borders of the block mountains which lie on the northern side of the folded Alps and similar ranges. Thus no mining centres of importance have arisen in the crystalline Alps or Pyrenees, whereas the eastern edge of the Auvergne, the rims of the Belgian and German highlands overlooking the great central plain, the

northern and southern rims of the Spanish tableland, the flanks of the expanded middle section of the Urals and the plateau of Finland are all foci of mining developments.

Iron and copper may, and do, occur associated with the Primary crystalline rocks, the former in masses (*e.g.*, in Sweden) and the latter in veins, (*e.g.* Sweden and Rio Tinto valley, South-west Spain). But iron occurs more often in association with coal on the numerous coalfields which lie chiefly outside this rim of highland, or, if within, then in basins like those of Bohemia and Hungary. Copper is plentiful, too, in Secondary shales of New Red Sandstone age among the upper valleys of highland Germany, more especially in Thuringia. Such shales are but poorly represented in other parts of the continent.

Salt Deposits and Chemical Industries.—The Secondary rocks of Central Europe, like their equivalents in England of New Red Sandstone type and age, contain immense deposits of salts, often attaining thousands of feet in thickness. Chlorides of sodium, potassium and magnesium occur in association with layers of gypsum along the northern foot-lands of the Harz Axis and the Carpathian Curve. The beds of Stassfurt and Spessart supply the materials for the great chemical industries of Saxony and Frankfort. The mines of Galicia (*e.g.*, Wieliczka) have yielded salt for centuries; a whole province (Salzburg) in the Austrian Alps takes its name from the salt mines which determine its industry.

A remarkable belt of volcanic rocks traverses the Secondary rocks of Central Europe from Rhineland to Prague. With this belt are associated many mineral springs famous for their medicinal value. Towns like Wiesbaden and Homburg. Carlsbad and Marienbad are centres for "taking the waters," which attract many thousands of visitors annually. Vichy is a similar centre in the volcanic Auvergne.

Agricultural Basins.—The Tertiary and Recent basins of the Ebro, the Garonne, the Seine, the Scheldt, the Po, the

Danube, the Euxine (except the large coalfield of the Donetz) and the Caspian streams have no mining industries and hence are agricultural rather than industrial basins.

The North German plain and its extensions into Denmark and Holland are similarly devoid of metals and given over to agriculture.

The Coalfields of Europe.—Apart from those of the Russian plain, the coalfields of Europe may be associated with the rims of the crust-block regions.

The *coalfield of Oviedo* in the Asturias, on the northern edge of the Spanish block, lies on the shore of the Bay of Biscay. Coal and iron are exported largely through Bilbao, Santander and Gijon.

Several small coal-basins occur on the eastern edge of the *Auvergne* plateau, and serve the machinery mills of St. Etienne and the silk factories of Lyons. Good iron is found just to the north at Creuzot in the Plateau de Langres, equivalent in age and formation to Cleveland ore.

The northern rim of the Ardennes upland, followed by the trough-like *valley of the Meuse*, marks the line of a rich coalfield which serves the woollen and linen industries of Lille in northern France, the machine and ordnance factories of Namur and Liège and the wool and glass industries of Aix (*or* Aachen). Continuing this line across the Rhine into the *valley of the Ruhr* we have the chief German coalfield with the busy centres of Elberfeld and Essen, the former famous for silks and the latter for Krupp guns.

The southern edge of the Ardennes mass bears the valuable though limited *coalfield of Saarbrücken*, a centre of Rhenish railway enterprise.

The Bohemian mass has a coalfield on the *Saxon* border serving the mining and textile industries of Germany's busiest province and a larger coalfield on the flanks of the *Riesen-Gebirge*, above Breslau, the Silesian capital. A third coalfield occurs around *Pilsen*, within the Bohemian border.

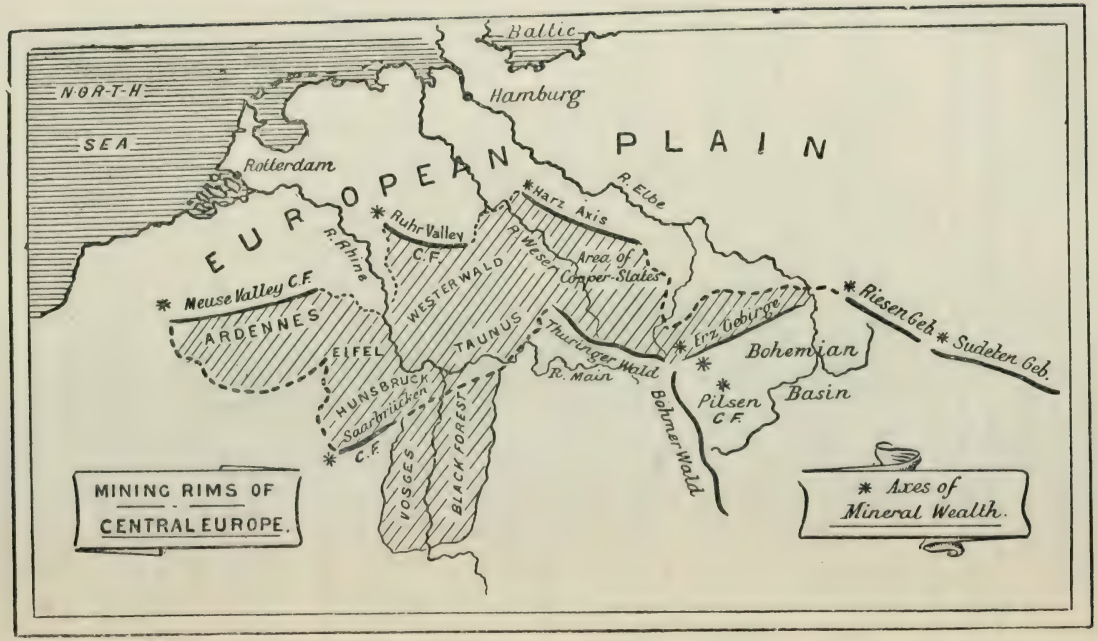


FIG. 211.—MINING RIMS OF CENTRAL EUROPE.

A small coalfield occurs in the angle between the Drave and the Danube on the Hungarian plain at *Fünfkirchen.*

The coalfields of the Russian plain, where strata lie practically horizontal, are largely covered by more recent deposits. The discovery of coal in *Poland* has renewed the life of Warsaw, the old Polish capital, and practically created Lodz, a town of 400,000 inhabitants.

Moscow has kept pace with European development through the opening of a rich coalfield around *Tula* to the south.

The coalfield of the *Donetz* basin, the largest in Europe in area, has brought prosperity to Kharkov.

Coal fortunately occurs in proximity to the mining centre of *Perm* in the Urals.

The Mediterranean and the Baltic depressions are practically devoid of coalfields.

Minerals of the Crystalline Rocks.—Coming now to the metallic ores associated with Primary crystalline rocks we may note their comparative absence in the Kiolen axis. The inner rim yields *silver* at Kongsberg just behind Christiania; *iron* of the magnetite variety is mined at Dannemora in the south of the Bothnian region and again at Gellivara mountain, near the upper end of the Bothnian Gulf. *Copper* ores occur around Fahlun.

The intensely folded ranges of the Alps and Pyrenees—mountains of recent origin—are exceedingly poor in economic minerals; the very ancient blocks of Central Europe are the chief store-houses of the valuable ores, and coalfields are close at hand.

Lead and *quicksilver* ores, mostly sulphides, occur along the southern edge of the Spanish "meseta" near Almaden and again across the Guadalquivir in Murcia, on the flanks of the Sierra Nevada.

Huelva exports great quantities of *copper* from the Tinto mines. The ancient crystalline peninsula of Brittany, like its counterpart, the Cornish peninsula, has *tinstone.* Small

quantities of *silver-lead* ores (so often found in association) are met with on the eastern edge of the Auvergne.

Belgium owes its wealth to the coal and iron, associated on its coalfield, rather than to other metal ores; but Luxembourg has in her ancient plateau mines of the best *iron* in Central Europe.

The Harz Axis yields *silver*, *copper* and *lead*, as well as *iron* ores, unassociated with coal. [The Thuringian forest, overlooking the *copper-bearing slate* basins, has valuable deposits of *lignite*, but these are not in the crystalline rocks.]

The rim of the Bohemian block-country is especially rich in valuable metals, though many mines are worked out. *Silver*, *lead*, *zinc*, *manganese*, *nickel* and *uranium* ores are mined in the Erz-Gebirge on both the Saxon and the Bohemian sides, Chemnitz and Joachimsthal being famous mining centres. The Riesen-Gebirge and the Sudetes stand only next in importance.

The folded ranges of the Carpathians are poor in minerals but the plateau of Transylvania within the curve of the range has *zinc* and *lead* ores. *Quicksilver* is found in Carniola.

The Mediterranean peninsulas of Spain and Turkey are said to be rich in undeveloped mineral wealth. Italy, on the other hand, an axis of recent uplift, is almost devoid of metals, except on those remnants of an ancient crystalline mass which now form the broken rim of the Tyrrhenian depression. Elba has long been famed for its *hæmatite iron*. Corsica and Sardinia remain undeveloped. Italy and Greece yield marble.

The distant region of Perm and Ekaterinberg in the N–S Ural axis yields *platinum*, *gold*, *copper* and *silver*. *Diamonds* also occur. We have noted a small coalfield.

Effect of Soil and Climate on Population.—Many causes contribute to the dense population over certain areas. Agricultural areas of average productiveness have a low density. Afforested regions are still less densely peopled. Bleak barren uplands, salt-wastes, steppe-country and marsh lands support little population. Arctic conditions militate

against development. But rich agricultural basins, coalfields, mining centres, shipping outlets, trade routes, all lead to vast congregations of people in towns, and densely populated areas each around a focus. These general principles may be worked out from a comparison of the climatic, agricultural, mining, and population maps of Europe, or indeed of any continent.

Distribution of Population.—The "black-earth" country around Kiev in the Euxine basin is densely populated for an agricultural region, and the density is increasing westward to Kharkov, with the development of the Donetz coalfield. The opening of the Tula coalfield has increased the aggregation of population around the ancient political centre of Moscow. Railway works, small-arms factories and machinery shops as well as textiles (under English management) find employment for the people. The founding of St. Petersburg on the Finland Gulf has led to the growth of the towns along the gulf. Many textile factories have sprung up and the inhabitants of these towns are much engaged in the exporting of timber and iron-ore.

Stockholm, as the capital, is the focus of Swedish population, with mining towns like Fahlun and Dannemora on the north and the towns of the Göta Canal depression on the south. The latter are largely engaged in weaving and in match making; deal and sulphur are readily accessible, the latter from volcanic deposits in southern Sweden.

The main channel into the Baltic has led to a group of towns springing up around Copenhagen. The fertile region of Scania, with a small coalfield, is the most densely peopled area in Sweden. Malmo and Helsingborg (the ferry port for Elsinore) stand on the Swedish side of the Sound, and Elsinore (the port of the old Sound "dues") divides with Copenhagen the Danish share of industry and commerce.

The courses of the navigable rivers over the fertile German plain, support considerable populations. Poland in the upper Vistula basin and Silesia in the upper Oder basin are more densely populated owing to mining and textile industries.

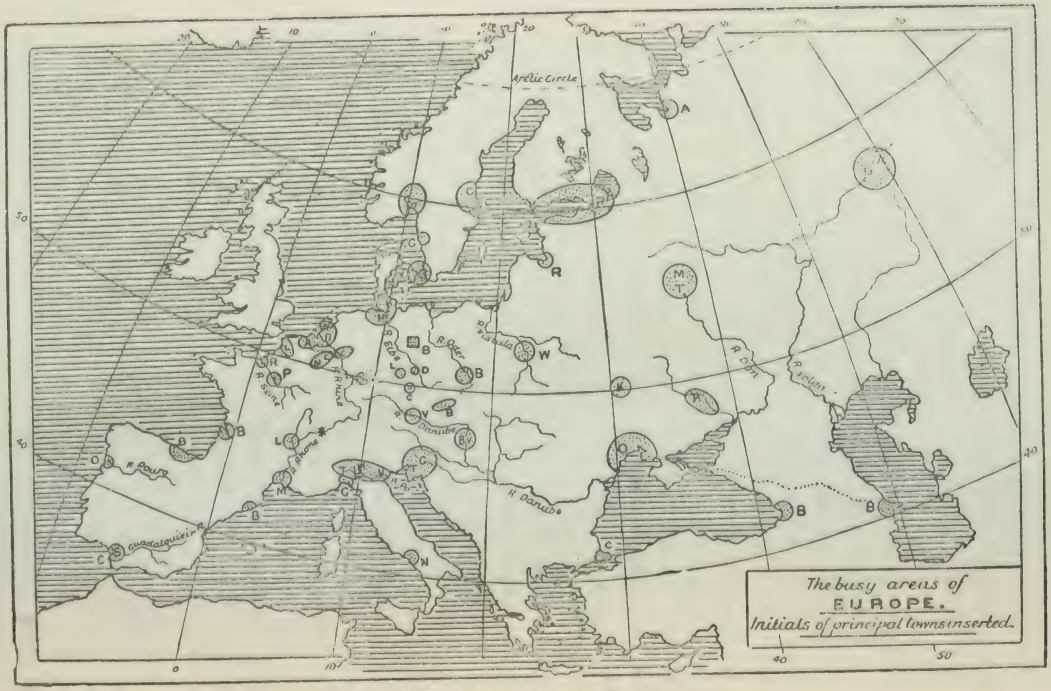


FIG. 212.— CENTRES OF POPULATION.

But the valleys of the Elbe and Rhine and Meuse (all draining to the open and never-frozen North Sea) afford the lines of densest population north of the Alpine trend.

The Upper Elbe drains Bohemia. It breaks through the Erz-Gebirge. The Middle Elbe skirts the edge of the Thuringian and Harz mining valleys. The lower river affords navigable communication with Hamburg, the greatest of continental ports.

The Rhine receives the streams of the Swiss valleys around Zurich. In its middle course it forms a main line of communication, and drains the most fruitful and delightful valley of Germany. In its lower course it forms a highway for ocean-going steamers from Cologne and the busy Ruhr valley to the densely crowded waterways of Holland that centre around Rotterdam.

The lines of the Meuse and Scheldt mark the most densely peopled country in Europe, viz., Belgium. Old and formerly pre-eminent towns in the Scheldt basin are dwindling while new and developing towns are growing apace in the Meuse basin. Antwerp, however, continues to flourish as the port of new as well as of old towns.

The Seine, from Paris to its mouth at Havre, is another main line of traffic. Rouen, with its group of cotton towns, stands nearly midway in the line.

The rich Austro-Hungarian plains have the population and political centres of Vienna and Buda-Pesth.

Graz is the focus of the mining industries of the Austrian Alps.

The Lombard Plain and the Italian Riviera, the environs of Naples and the delta of the Rhone form the chief centres of population in the Mediterranean region.

The extreme fertility of the Po basin, the growth of the silk industry, as well as the past political history of the plain, have resulted in dense aggregates of towns around Turin, Milan and Venice.

Genoa, the rival of Venice, past and present, and *Naples*, the chief city of Southern Italy, *Marseilles*, the French gate to the Mediterranean, *Barcelona*, one of the few manufacturing centres of Spain, and *Oporto*, the outlet of the port wine basin of the Douro, and *Odessa*, the gate of wheat and wool exports from South Russia, form subsidiary centres of population.

The Sparsely-Populated Areas.—These include the dry plateau of the Spanish "meseta," the high pastures of the Alps, the marshes of the Pripet just east of busy Poland, the Caspian depression, and Europe generally north of the Skagerack-Göta-St. Petersburg depression.

Table of Populations (for reference only).—Towns having more than half a million inhabitants; population given in round numbers. The principal ports are given at the end of Chapter IV.

London ...	4,523,000	Warsaw ...	781,180
Paris... ...	2,888,000	*Liverpool* ...	747,000
Berlin ...	2,070,690	Naples ...	723,000
Vienna ...	2,032,000	*Manchester*...	714,000
St. Petersburg	1,907,700	Brussels ...	665,800
Moscow ...	1,481,200	Milan ...	599,200
Constantinople	1,200,000	Munich ...	595,000
		Amsterdam...	574,000
Hamburg ...	932,100	Madrid ...	571,500
Budapesth ...	880,370	Barcelona ...	560,000
Glasgow ...	784,000	*Birmingham*	526,000

(The student should construct a similar table of towns having populations between one half and one quarter of a million.)

CHAPTER IV.

Communication by River, Rail and Sea.

[Maps to be studied: Railway Map, Steamship Routes, Orographical Map of Europe.]

Besides considerations of fine climate, rich lands, the presence of coal and the useful metals, the natural means of communication by navigable river, and open sea, are important factors in determining the aggregation of peoples and the growth of industries.

The Great Continental Rivers.—Pre-eminent among the river-highways of the Continent, as we have already seen, are the Elbe and the Rhine, which not only traverse lands rich with vines and metal, but give access, for far-away countries like Switzerland and Bohemia, to an open sea, across which are the shores of England. Hamburg and Rotterdam, the population centres at their mouths, rank among the foremost ports in Europe. The German rivers Oder and Vistula mark other lines of aggregation and offer communication with the Baltic for the mining and manufacturing centres of Silesia and Poland respectively. But they are lines secondary in importance to the Elbe and the Rhine, partly because they

open to the Baltic, a sea frozen for 100 to 130 days in the year. The *Dniester* and the *Dnieper* take opposite courses to the *Vistula* and the *Duna*, and traverse the "black-earth" country to the ports on the Black Sea. The great slow-moving rivers of the Russian plain, and especially the *Volga*, which opens into an inland lake, are chiefly serviceable in lieu of canals. The *Rhone* flows too rapidly for much navigation. The *Seine* is available only for small craft as far as Paris. The rivers of the Spanish tableland are chiefly of the "wady" type—shrinking considerably in the dry season—and hence are of little service for navigation. The *Po* is more useful for the irrigation of the rich Lombard Plain than for navigation.

Next in importance to the great highways of the Rhine and the Elbe comes the *Danube*, which links Bavaria, Austria-Hungary and the free States of the Balkan peninsula with the Black Sea. Shallows in Austria, and rocks in the Carpathian region, together with deltaic deposits at its outlet have considerably hampered its usefulness. Canalisation of the "Iron Gate" and dredging the main channel of the delta have enhanced its value. Since it opens on a sea whose only outlet is the narrow passage of the Dardanelles, itself leading into an inland sea, it must serve ever as an inland line of communication rather than as a water-highway of first importance (See Maps in Part II. of this section.)

European Canals.—Canals are best developed in France, where all the main river-systems are connected with one another and with the Rhine. The rivers of the North German plain are linked along an east and west mid-line through Berlin. The flats of Holland and of Flanders are intersected by innumerable canals, easy of construction, and fed by water from drainage machinery.

The trough between Bothnian Sweden and South Sweden, including the Göta and the Lakes Wener and Wetter, is canalised, where necessary, so that small craft can cross from Gothenburg to Nörköpping.

Important Ship Canals.—The opening of the Suez Canal (in which England has the predominant share) has made the Mediterranean the great mid-continental highway from Europe to India, China, Japan and Australia, so that now trunk-lines of railways make for the packet stations of the Mediterranean from London, Paris, Brussels, Cologne, Berlin, Dresden and Vienna. These we shall note in our study of the railways. The North Sea and the English Channel offer lines of communication for European ports with the Atlantic, and hence with the outer world. They are also crossed by numerous "ferry" lines of steamships connecting the industrial centres of the British Isles with those of Germany, Holland, Belgium and France.

The Baltic, on the other hand, is an inland sea, freezing in some parts for three months in the year, and in others for five. Moreover, it offers no "thoroughfare," and entrance is by the stormy channels of the Skagerack and Cattegat. The opening of a ship canal across the "fenland" isthmus of Schleswig-Holstein, from the North Sea to the Baltic, makes safe and rapid entrance and exit possible, and should lead to a great development of Kiel.

The earlier Helder Canal to Amsterdam has largely given place to the newer and shorter Haarlem Ship Canal, which once more makes Amsterdam a port of considerable importance. (Maps showing the canals are given in Part II. of this section).

Railway Communications.—The development of coalfields and of mining and machine-weaving industries has shifted the centres of population somewhat and led to the necessity of railways to meet the demands of quick transit and increased traffic. The main lines of railway communication naturally serve to connect all the great European capitals with one another, and then with the areas of production, whether farming, mining or weaving, on the one hand, and with

FIG. 213.—MAIN LINES OF COMMUNICATION.

the shipping centres of distribution on the other. Keeping this in our minds, we trace—

(*a*) A main line of communication between Madrid and Moscow, through Paris, Brussels, Cologne and Warsaw, to St. Petersburg and Moscow.

(*b*) A main line from London, through Belgium, Frankfort, Nürnberg, Vienna, Buda-Pesth and Belgrade, to Constantinople.

(*c*) A main line from London, through Paris, Lyons and Turin, for Brindisi, a port of embarkation for the Suez and the East.

Other systems of first importance are—

(*d*) A line linking Hamburg and Berlin, through Hanover, with Frankfort, Basel and the Lombard cities, and Genoa.

(*e*) The joining of St. Petersburg, through Warsaw, Brunn and Vienna, with the Adriatic.

(*f*) The Elbe Railway from Hamburg and Berlin, *via* Dresden and Prague, to Vienna.

(*g*) The Oder-Dniester depression route from Berlin to Odessa, calling at Breslau, Cracow and Lemberg.

Other routes will be traced in dealing with the separate countries.

It is worth while noting the relations of these trunk systems to physical features. In most cases the line of least resistance—compatible with quick transit and utility to the communities—is taken.

(*a*) *Madrid to Moscow.*—The line from Madrid drops from the plateau into the valley of the Ebro, which it follows to its source near the Biscayan shore. It creeps round the foot of the Pyrenees and strikes across the flat shores of the Bay of Biscay, through the gap between Brittany and the Auvergne, to Paris. It then avoids the highlands of the Ardennes and Rhineland, and follows the great European plain past Brussels and Hanover to Berlin along the middle depression of the plain

(marked by east-west streams, like the Spree and Warthe), whence it branches at Warsaw for Moscow, the ancient capital, in the centre of the Russian plain, and for St. Petersburg, the modern capital, on the Finland arm of the Baltic. No serious obstacle is presented to the engineer along this route.

(*b*) *London to Constantinople.*—The Orient expresses from Ostend or Rotterdam seek the valley of the Rhine as far as Bingen, then follow the Main past Frankfort, cross over at Nürnberg into the basin of the German Danube, and follow that highway from Ratisbon to Belgrade. They next climb the valley of the Morava as far as Nish, strike across the Balkans in the pass of Sofia, and descend the fertile vale of the Maritza on their way to Constantinople.

(*c*) *London to the Orient.*—Paris is gained from London by many alternate routes across the Paris basin. The line then climbs the oolite plateau of Langres by one of the head-stream valleys of the Seine and descends the vale of the Saône to Lyons. The route makes direct for Turin by means of the Cenis tunnel, the first of Alpine tunnels. From Turin it skirts the base of the Appennine range and the shores of the Adriatic Sea till it reaches Brindisi.

(*d*) *Hamburg and Genoa.*—Hamburg and Berlin are placed in communication with Frankfort by lines over the German plain through Hanover and Halle. The routes take valleys in the Thuringian Forest to converge on Frankfort. Henceforward the route is up the Rhine valley to Basel, then up the picturesque Reuss valley past Lucerne to Göschenen, through the St. Gotthard Mountain, down the equally charming valley of the Italian Ticino, and along the edge of Lake Maggiore. From this valley it strikes across the Lombard Plain giving off lines to Turin, Milan, Venice, and Brindisi before climbing the gap of Alessandria to descend and terminate in Genoa. Thus, in a non-political sense, Germany has a port on the Mediterranean as France has Marseilles and Austria has Trieste.

FIG. 214.—THE MEDITERRANEAN HIGHWAY.

(*e*) *St. Petersburg and the Adriatic.*—A very direct line of communication links St. Petersburg, the greatest city of the north, with Trieste. It crosses the lake plateau of Baltic Russia, through Dunaburg, to Warsaw, in the productive agricultural and textile industrial region of Poland. It then follows the valley of the Upper Oder and the busy industrial region of Moravia in the trough of the March, between the block-country of Bohemia and the volcanic uplands of the Tatra Group. From Vienna it follows the mining valleys of the Eastern Alps *viâ* the Semmering Pass, calling at Graz or Laibach on opposite sides of the Carinthian Alps before descending to the Adriatic at Trieste.

(*f*) *Hamburg and Vienna.*—Hamburg and Vienna are connected by rail through Berlin, Dresden and Prague, the capitals respectively of Germany, Saxony and Bohemia. The line follows very closely the course of the Elbe, and is one of the most important lines of traffic and industry on the continent.

(*g*) *Berlin to Odessa.*—The Black Sea port of Odessa is the terminus of an important system joining up Hamburg, Berlin, Breslau, Cracow and Lemberg. The line crosses the German Plain, follows the course of the Oder in Silesia, where it serves the mining districts near Breslau, and then skirts the outer edge of the Carpathians, calling at Cracow near the source of the Vistula, and Lemberg near the source of the Dniester on its way to Odessa. The whole course is over tolerably level country, agricultural in character.

European Ports.—It will have been noted that the main lines of railway serve to connect industrial areas and capitals with the principal ports. It is through her ports that Europe communicates with the outer world. Canada, the States, South Africa, Australia, Japan, the Indies (East and West), and the great Republics of South America, trade with the European nations through her ports.

The ports on the Caspian Sea must always remain local in character, shut in on the shores of an inland sea.

The ports on the Black Sea have only the narrow gate of the Dardanelles by which to gain access to the main line of traffic, which strikes east and west across the Mediterranean, and which, though always an important line, has grown supremely so since the opening of the *Suez Canal.*

Mediterranean Ports.—England, by her possession of Gibraltar and her predominant share in the Suez Canal, holds the keys of this important route.

Barcelona is the first of Spanish ports.

Marseilles commands the French trade on the Mediterranean.

Genoa rivals her and Venice in volume of trade, especially since the sub-Alpine tunnels have gained access for Germany to this Mediterranean port. Naples, the largest city of Italy, is not chiefly famous as a port. Venice has for centuries served the fertile Lombard plain. Brindisi has importance as a packet station on the P. and O. line, but much of its work has been transferred to Marseilles, which is also the headquarters of the "Messageries Maritimes."

Trieste links Vienna with Mediterranean interests, and Fiume serves Buda-Pesth and the Hungarian plain in a similar way.

Constantinople is the capital and port of European Turkey, finely placed on the Bosphorus gate of the Black Sea. Salonica and Gallipoli export Turkish products. Athens has her port of Piræus.

Odessa dominates the Russian wheat and wool trade of the Euxine. Taganrog is the port of the shallow sea of Azov. Poti and Batoum have risen into importance since the development of the petroleum industry at Baku, with which town they are connected by pipes and a railway.

Baltic Ports.—The Baltic Sea is much less salt than the open ocean, and lies in cold temperate latitudes. It therefore is liable to freeze; the North Sea outside, more salt, but in the

same latitude, never freezes. The Bothnian arm freezes for as many as *five* months in the year, and even the entrance is blocked on the average for *three* months in the year. Until the opening of the Kiel Canal, the Baltic had practically only one gateway—the deep channel of the Sound. The deeper channel of the Great Belt serves as a roadstead for the Danish Fleet; the shallow channel of the Little Belt is useless for ocean-going vessels. The Göta canal is not available for large craft.

The corn and forest lands of Central Russia find their principal outlets in Riga and Memel. St. Petersburg, the modern Russian capital, the creation of Peter the Great, stands at the head of the busy Gulf of Finland, guarded against the invader by the fortified island of Kronstadt. Finland exports her timber and iron through numerous little ports on the gulf (Helsingfors, Abo, etc.).

Sweden sends timber and ores of copper and iron from Gefle, matches and textiles from Nörköpping, and agricultural produce from Malmo; but her chief gateway is the ice-free port of Göteborg (Gothenburg) on the open channel of the Cattegat.

The Sound has the busy Danish capital of Copenhagen ("merchant's haven,") and the old town of Elsinore.

At the mouth of each of the German rivers stands a port sheltered and partly hindered by the tongues of sand—*nehrungs*—which characterise this coast. Each port has, therefore, an outport, easier of access to the larger vessels constructed in these days of steam transit. Königsberg has Pillau; Danzic has Hela; Stettin, the port of Berlin, is served by Swinemünde. (*See* Fig. 215.)

Kiel is gaining in importance, and somewhat at the expense of Lubeck, by the opening of the ship-canal across the isthmus. It is also the head-quarters of the Baltic Fleet.

Ocean-Facing Ports.—On the ice-free Atlantic border many of Europe's greatest ports have sprung up, doing most of the

FIG. 215.—TRADE ROUTES IN THE NORTH SEA AND THE BALTIC. [*To face p. 350.*

trade with America and Australia. Hamburg, the premier port of the continent, as it is of Germany, deals with the exports of manufactured goods and the imports of coal and raw materials for the busy valley of the Elbe. Altona shares its trade, and Cuxhaven serves as outport. On the neighbouring estuary of the Weser stands Bremen, the headquarters of the North German Lloyd steamers, which join with the Hamburg-American Line in offering passenger facilities for America. Bremerhaven is the outport, and opposite lies Wilhelmshaven, the naval base of the North Sea German Fleet.

Norway has Christiania and Bergen, the former the capital and the latter the chief fishing centre.

Holland has Amsterdam and Rotterdam, rivals for many a century, the former the focus of Dutch industry and the latter the gate of the Rhine provinces. Canalisation has led to the prosperity of both. The newer Haarlem Canal, replacing the longer and shallower Helder Canal, has accelerated the prosperity of Amsterdam. The canalisation of the Rhine embouchures has similarly enhanced the commercial value of Rotterdam's position.

Antwerp runs Hamburg closely for the first place among continental ports. The gate of Belgian trade, with the most densely peopled hinterland in Europe, on a deep and slow-flowing river—it has immense trade with all parts of the world, and especially with the wool-producing countries of South America and Australia. Ternuezen, lower down the river, connected by canal with Ghent, secures some of the trade of the Flemish area.

Dunkirk, a French port on the Belgian border is rising rapidly in importance as the gate of the woollen area of Lille and Roubaix on the coalfield of the Pas de Calais. Havre stands at the outlet of the Seine, with Rouen's cotton mills, Paris, and the wine country of Champagne behind it. It is the principal port of France for Atlantic trade. It far

outrivals Nantes, the gate of the agricultural basin of Touraine. and Bordeaux, the export town for the claret wine of Aquitaine. Cherbourg is a port of call for American steamers of the German Lines, as well as the headquarters of the French Channel Fleet.

Bilbao has grown rapidly as the port of the Spanish Biscay since the development of the coalfield of Oviedo. Portugal has Oporto (*O porto*—the port), the outlet for the "port" wine of the Douro basin, and Lisbon, which is less important as a port than as a capital, though it has a splendid harbour. Huelva exports the copper of the Rio Tinto mining region and Cadiz the live-stock and fruits of the fertile Andalusian basin.

Populations of the Principal Ports (for comparison only).—

Hamburg ...	932,100	*Bristol* ...	357,000
Glasgow ...	784,000	Lisbon ...	356,000
Liverpool ...	747,000	Stockholm ...	342,000
Naples ...	723,000	Palermo ...	341,600
Barcelona ...	560,000	Antwerp ...	320,600
Copenhagen	559,390	Riga	318,400
Marseilles ...	550,600	Hull	278,000
Odessa ...	478,900	Genoa ...	272,000
Rotterdam ...	427,000		

PART II.

THE COUNTRIES OF EUROPE.

CHAPTER V.

France.

Approximate Co-ordinates of—

Paris: $2\frac{1}{2}°$E., 49°N. Marseilles: $5\frac{1}{2}°$E., 43°N.

France lies almost entirely south of the line 50°N. Lat., whereas the British Isles lie north of this line. Its average latitude is 47°, or 7° nearer the Equator than the British Isles. The meridian through Paris divides the country into an eastern and a western half. The western segment is open to the influences of the Atlantic, unimpeded by any archipelago. The eastern half includes all the highland (if we omit the low axis of Brittany), together with the long, narrow Rhone-Saone depression which opens to the Mediterranean. With the exception of the wall of the Pyrenees, dividing Spain from France, all the land frontier lies on the eastern limit of the eastern half. Over this line stand Belgium, Germany, Switzerland and Italy.

The area of France is roughly $3\frac{1}{3}$ times that of England and Wales, or nearly twice that of the British Isles. It is

rather less than that of Germany. Taking England and Wales as the unit of area, we may compare France with Germany, Italy, Russia and the whole continent of Europe :—

England and Wales.	Italy.	France.	Germany.	Russia.	Europe.
1	$1\frac{2}{3}$	$3\frac{1}{3}$	$3\frac{1}{2}$	30	60

Geological Structure.—The geological structure of the country offers many points of comparison with our own country. The low, hilly peninsulas of Brittany and Cotentin resemble our Cornish peninsula, from which they are separated by the sea-filled trough of the English Channel. The Paris and the Bordeaux Basins are Tertiary areas, corresponding very remarkably (and especially in the former case) with our Hampshire and London Basins. The Rhone depression and the Mediterranean coastal plain are covered with Tertiary deposits of the Mediterranean type. Contrasting with the low axis of ancient Brittany, we have the lofty recently-elevated axes of the Pyrenees and the Alps, effectually dividing France from Spain and from Italy respectively. Standing in the interior, and dividing the basins, though draining chiefly to the Atlantic outlets, we have the ancient crust-block of the Auvergne, with its crowd of recently-extinct volcanoes, many of whose forms have been little altered by subsequent denudation. Cutting France off from Switzerland, we have the parallel folds of the Limestone Jura, similar in character to the Oolite Limestones of the Côte d'Or and Plateau de Langres, which are the gathering ground of the head streams of the Seine, just as the Oolite Limestone Cotswolds of England feed the headstreams of the Thames.

The map inserted in this section shows that, though the Loire Basin now drains to the Bay of Biscay (owing to a change of slope), yet it originally belonged, and still *geologically*

belongs, to the Paris Basin. The parallelism of its head-streams with those of the Seine serves to remind us of this.

The features of the Paris Basin are carried across the frontier into Belgian Flanders. But the ancient slate plateau of the Ardennes is unlike anything found in France. The rich coalfield which fringes its northern rim along the valley of the Meuse does fortunately extend into France underneath the Tertiary and Secondary deposits of the *Pas de Calais*, Else France, apart from a few small coalfields in the valleys of the Auvergne near St. Etienne, would be destitute of coal. This is the case in the Bordeaux Basin, but the coalfield behind Bilbao, Oviedo and Gijon on the Spanish Biscay is in close proximity.

The charming scenery of the Riviera is the outcome of earth-sculpture of very ancient volcanic rocks combined with luxuriant vegetation.

Rainfall in France.—Rainfall corresponds to that of our English eastern counties, except on the plateaux and mountain

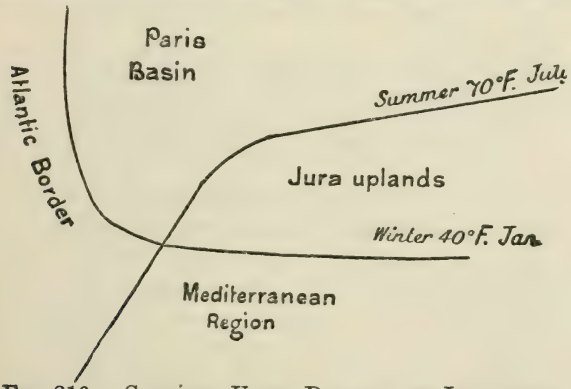


FIG. 216.—CLIMATIC UNITS DEFINED BY ISOTHERMS.

chains. Biarritz stands at the focus of the rainiest region—in the S.E. corner of the Bay of Biscay. The Cevennes, the culminating ridge of the Auvergne plateau has considerable

rainfall. The provinces of Brittany, and those along the English channel, are rainy above the average. The facts agree with what one would expect when it is remembered that rain winds drive in from the Atlantic either along the axis of the English Channel or in a south-easterly direction across the Bay of Biscay.

Climatic Regions.—The isotherms divide France into four fairly distinct climatic regions. (*See* Fig. 216.)

The *Paris Basin* experiences similar climatic conditions to those of the south-east of England, with a slightly higher average annual temperature.

The climate of the *Atlantic Border* corresponds in type to that of Cornwall, being damp and equable and increasingly warmer as we travel southward.

The *Rhone Depression* falls within the Mediterranean region as regards drainage, climate and productions.

The flat-topped limestone hills of the *N.E. corner of France* are least open to oceanic influence, and exhibit the widest range of temperature, though extremes are modified by considerable rainfall.

Agriculture.—The comparative *scarcity of coal* combined with the genial climate and fertile soil of the three drainage-basins makes France an *agricultural* rather than a manufacturing country. If we leave out the navigable Seine from Paris to Havre, the Belgian frontier coalfield, and the population centre of Lyons and St. Etienne, we have what is almost a purely agricultural country. The rainy and hilly peninsula of Brittany is suited excellently to dairy farms; the Paris and Bordeaux basins yield abundant wheat and wine. The Mediterranean region yields, in addition, fruits characteristic of that climatic province, as well as maize and the mulberry.

French Manufactures.—Except perhaps pottery, these are confined to the three densely peopled areas mentioned above. Paris makes a great variety of articles for home and

personal decoration, much "Birmingham" ware, and has many glass and pottery works as well as gun factories. Rouen is the centre of the cotton industry. Havre is the port of the Paris Basin, and has much trade with the two Americas. Lille is the focus of population on the northern coalfield, where the linen and the woollen industries have aggregated, the former at Lille and the latter at Roubaix. Dunkirk's prosperity has developed with the import of wool and the growth of the industry. Lyons remains the headquarters of the silk industry, introduced at the beginning of the sixteenth century; mulberry trees are cultivated and silkworms reared in the Mediterranean region; coal occurs around St. Etienne, where the looms are made from iron obtained in the oolitic plateau around Creusot, to the north of the population centre of Lyons. Creusot has a small coalfield and forms a subsidiary industrial centre, and is served by the Canal du Centre. Nancy, too, has ironworks, close to the German frontier and within easy access of the excellent Luxembourg iron. Marseilles is the gate of trade, dealing with all Mediterranean countries and the far East *viâ* the Suez Canal.

The fruitful basins of the Loire and the Garonne find outlets for their produce in Nantes and Bordeaux. Tours in the former and Toulouse in the latter are population and traffic centres. Nantes has considerable fishing trade.

MAIN DIVISIONS OF FRANCE.—For the purpose of sketch maps, and convenience as *geographical units*, it will be well to consider in detail the three drainage basins sloping respectively towards the Channel, the Biscay and the Mediterranean.

(*a*) **The Seine Group of Streams and the Paris Basin.**—The watershed on the east is the limestone Plateau de Langres, which culminates on its eastern edge in the Côte-d'Or. Descending from this plateau are the nearly parallel and equal streams of the Yonne, the Seine, and the Marne, which

coalesce on the plain above Paris much as the head waters of the Thames do above Oxford. The soil is of the same formation as that of the Cotswolds, but the warmer slope of Langres is suitable for the vine, and the rich province of Champagne gives its name to the variety of wine which it produces. Chalons and Epernay, both on the Marne, are

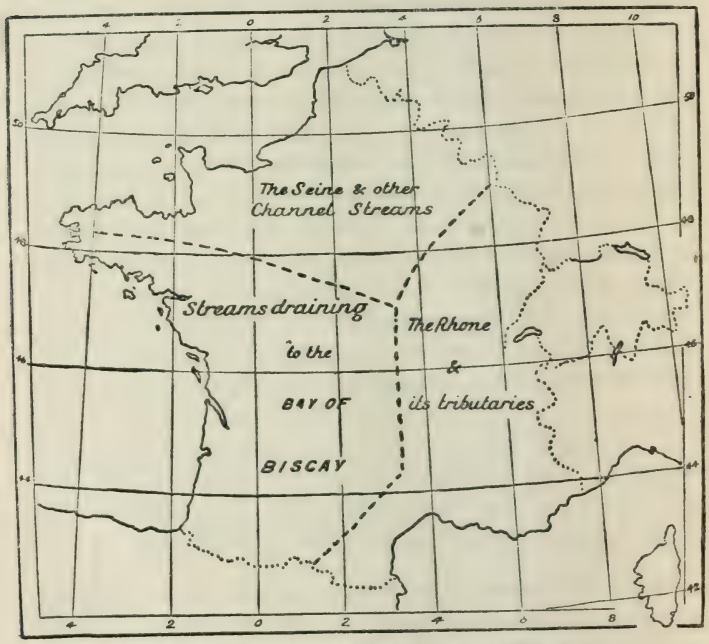


FIG. 217.— TRIPARTITE DRAINAGE OF FRANCE.

centres of the industry. The ancient and historic city of Rheims stands just to the north. The Marne-Rhine Canal links these wine centres, through Nancy, with the towns of the German Rhine. Standing on the southern edge of the watershed is the cathedral city of Chartres. The Seine receives one important tributary below Paris, and this from the northern frontier rim of the Ardennes.

Rising close to the Marne, but finding its way across the Ardennes country to Belgium and the North Sea is the Meuse, and further east is the Upper Moselle, which is deflected by the Ardennes and empties itself into the Rhine at Coblentz.

Below Paris, the capital and centre of French life, the Seine meanders slowly across the plain of Normandy, past busy Rouen, to Havre the shipping outlet of the basin. The orchards of Normandy are famous for apples and pears; the oolite building stones of Caen and Bayeux are equal to the similar stones of Bath and Portland in our own country. The line of the lower Seine is a line of dense population; the river is sufficiently navigable for barges and small steamers to make Paris a port, and many industries have grown up in the suburbs of the city; ordnance-factories, dye-works, glass manufactories, and potteries (at Sèvres) are among the chief. Versailles is famous for its palace, built by Louis XIV.

Rouen has Elbœuf as port; Havre has Harfleur.

Parallel with the Seine, and separated from it by chalk hills which terminate seaward in the cliffs of Dieppe, is the smaller stream of the Somme. The old woollen-weaving town of Amiens is the focus of its industry and life; but work and workpeople are concentrating more on the Franco-Belgian Coalfield, which slopes away from the Somme along the valleys of the Scheldt and Meuse towards Belgium.

Lille is here the most populous centre and the head-quarters of the textile trades, especially woollens. Roubaix and Tourcoing thrive in the vicinity. Cambrai and St. Quentin have linen factories, and Valenciennes is well known for its lace; Dunkirk is the sea-gate. All are in French Flanders, and Flemish weavers were renowned long before the days of coal and machinery.

Between the Somme and the frontier stand the battlefields of Crecy (1346) and Agincourt (1415).

Calais and Boulogne share with Dieppe the passenger traffic between the two great capitals, London and Paris.

The rocky peninsula of Cotentin terminates in the Cap de la Hogue, and carries the important naval centre of Cherbourg.

The ports of the Channel coasts of Brittany, especially St. Malo, send butter and poultry, fruit and vegetables to the English markets.

(*b*) **The Biscay Streams and the Auvergne.**—The stormy Bay of Biscay receives the waters of the Loire and of the Garonne and their numerous affluents. The *Loire* and its principal tributaries rise on the volcanic plateau of the Auvergne, close to the Cevennes rim, and flow in nearly parallel courses over its north-western slope to the fertile basin of Touraine. Before emptying itself into the Biscay it receives a number of tributaries from the Normandy divide. A series of small streams drain the southern slope of the Brittany upland axis. The *Garonne* itself rises in the lofty Pyrenees, close to their culminating point, but receives its principal tributaries from the southern edge of the Auvergne and Cevennes. It drains the rich basin of Aquitaine, which is separated from the coast by the less fertile, sandy, fenlike country of the Landes.

The desolate uplands of the Auvergne offer little hospitality to population, though much of interest to the geographer. A trunk line of railway from Paris to Marseilles follows the valley of the Allier across the tableland and calls at Vichy, famous for mineral springs, and Clermont, the tourist centre for exploration of the numerous "puys" and other volcanic features of the region. St. Etienne has sprung up on the eastern edge of the plateau, owing to a coalfield existing in the vicinity, but belongs rather to the Lyons basin. The Loire takes a northward course, as if to join the Seine; but at Orleans is deflected westward through the charming country of Touraine, in the centre of which stands the lace and embroidery-weaving city of Tours. The angle of the river, however, is marshy and unhealthy. Limoges, famous for pottery and enamels, stands

on the Upper Vienne, close to the Auvergne border. The battlefield of Poictiers (1356) lies in the lower basin of the same river. Le Mans, a railway centre on the great west route to Brest, stands on the Sarthe, a tributary from the north. Nantes is the gate of trade to this agricultural basin. It imports much timber from the Baltic provinces. St. Nazaire is its outport; currents are difficult. The export of sardines is of considerable importance. The ports have trade with Central America and the West Indies. Between the Loire and Garonne lies the small basin of the *Charente*, with Cognac, famous for brandy, and the fortified ports of Rochefort and La Rochelle on the seaboard. Toulouse is the centre and Bordeaux the outlet of the Garonne Basin. The *Lot* and the *Dordogne* are very considerable streams from the Auvergne. A canal (Canal du Midi) carries the line of inland navigation from the Garonne at Toulouse over to the quaint mediæval town of Carcassonne and forward to the Mediterranean. The basin of Toulouse yields wheat, wine and tobacco. Bordeaux is the centre of the claret trade; Pauillac is its outport. It is an important station on the line from Paris to Madrid, about 400 miles from the former and 900 from the latter. Between the Garonne and the smaller parallel *Adour* lie the alluvial flats of the Landes.

A tributary valley of the Adour contains Pau, a tourist centre for the Pyrenees. Bayonne, which gives its name to bayonets, stands at the mouth, and much-frequented Biarritz, on the French side of the frontier, is situate a few miles to the south.

(*c*) **The Rhone-Valley.**—The Rhone-Saone depression differs from the other catchment-areas of France in being a trough rather than a basin. It is shut off from the Paris Basin by the Plateau de Langres, which has been separated from the geologically similar oolite ranges of the Jura by the deep incision of the Saone. The slope from the plateau to the Saone is called the Côte d'Or. The tributary stream of the

Doubs, which bends back on itself by following two parallel valleys in opposite directions, drains from the eastern border formed by the Swiss Jura. The uplands are monotonous, but the valley is filled with rich vineyards; Burgundy wine centres are Dijon and Chalons-sur-Saone. Creusot, at the southern end of the Côte d'Or, offers oolitic iron-ore similar to our Lincolnshire and Cleveland iron.

The Rhone flows from Lake Geneva to join the Saone at Lyons, the focus of population in the valley. Henceforward the latter is known as the Rhone, taking its name from the larger stream. Raw silk is plentifully produced in the valleys to the south; coal is available at St. Etienne and iron at Creusot, hence the retention of the silk industry at this confluence. South of the junction of streams, the valley is bordered on the west by the Cevennes rim of the Auvergne, and on the east rise the majestic Alps, with their highest peak, Mt. Blanc, actually within French territory. To the south of this monarch of European mountains stands Mt. Cenis, near to which engineers pierced the first tunnel through the Alps to the Italian plain. Through trains could then travel from Paris to Brindisi, the eastward terminus of the once famous Overland Route, latterly not so popular owing to the use of Marseilles as a port of call for eastward-going steamers. The Alps contribute the Isère and the Durance, but the abrupt wall of the Cevennes yields no tributaries of importance.

At Avignon, sometime the home of the popes (1309-1417), the valley opens out upon the coastal plain, where the river breaks up into several distributaries, of which two are more important than the rest. Nîmes has an interesting history, possesses considerable industry and is the meeting-place of railways from north, south, east and west. Cette is the eastern terminus of the Canal du Midi. Marseilles, France's chief port on the Mediterranean, and rivalling Genoa in trade, is the gate of the basin, but stands some thirty miles away from the delta. Between Marseilles and her rival is the

FIG. 218.—GEOLOGICAL SKETCH MAP OF FRANCE. [To face p. 362.

"garden" of Provence, with its lovely coast known as the Riviera. Toulon is the headquarters of the French Mediterranean Fleet. Cannes, Nice, Monaco and Mentone are much-frequented spots on this charming coast, once, long ago,

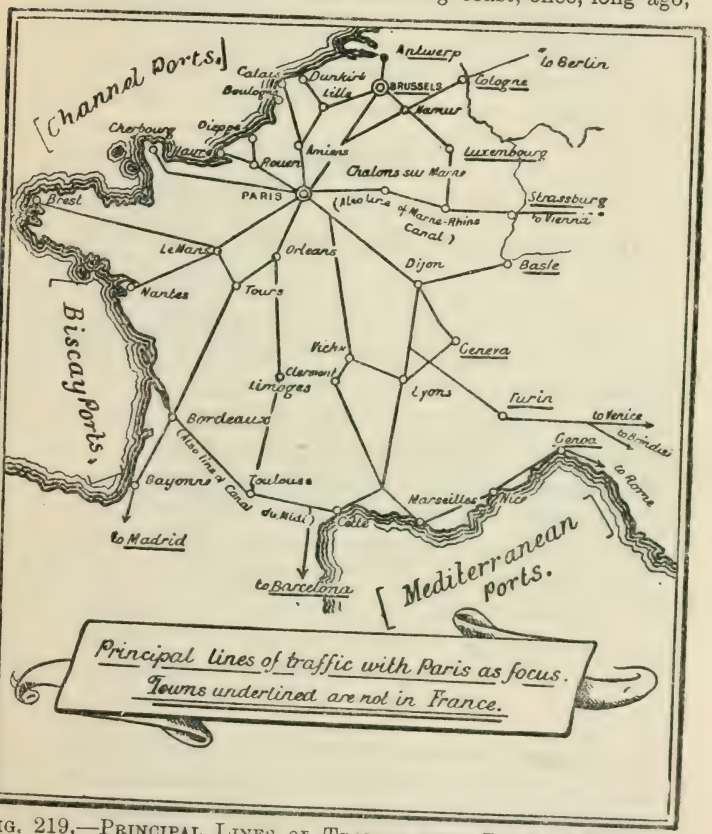


FIG. 219.—PRINCIPAL LINES OF TRAFFIC WITH PARIS AS FOCUS.
(*Towns underlined are not in France.*)

in the Permian (New Red Sandstone) age, desolated by volcanic disturbance. They look out towards Corsica, the mountainous island which gave Napoleon to the French nation.

CHAPTER VI.

Belgium.

APPROXIMATE CO-ORDINATES OF BRUSSELS: $\frac{4\frac{1}{4}°\text{E.}}{50\frac{3}{4}°\text{N.}}$

THE small but densely-peopled and prosperous kingdom of Belgium lies along the northern frontier of France and opposite the mouth of the Thames, with whose valley it has many geological affinities. It is separated from Holland on the north by the sandy Kempen (or Campine), across which flow the navigable highways of the Scheldt, Maas and Rhine distributaries. Brussels, its capital, stands in the middle of the kingdom, and about equidistant from London, Paris, Amsterdam, and Frankfort, the premier city on the Rhine. By its rivers all parts have easy access to the busy narrow sea between the British Isles and the Continent. The average latitude is that of Portsmouth; Brussels is 4½° East of London.

Geological Structure.—Geographically the kingdom is made up of two strikingly contrasted units, which correspond very closely with the drainage areas of the Scheldt and the Meuse. The line of the Sambre-Meuse trough is the geological dividing line between east and west. The *western basin*, that of the *Scheldt* with its tributaries the Lys and the Senne, is filled with soft Tertiary and Recent rocks, like those of the Paris and London Basins. The *eastern basin*, corresponding with the

Belgian catchment-area of the *Meuse*, is occupied by the hard ancient slaty uplands of the Ardennes.

Belgian Rivers.—The equal streams of the Lys and the Scheldt start back beyond the French frontier and the united stream empties itself by a long deep estuary, most of which is beyond the Dutch frontier. The Meuse, too, rises south of the French frontier, on the oolite uplands of the

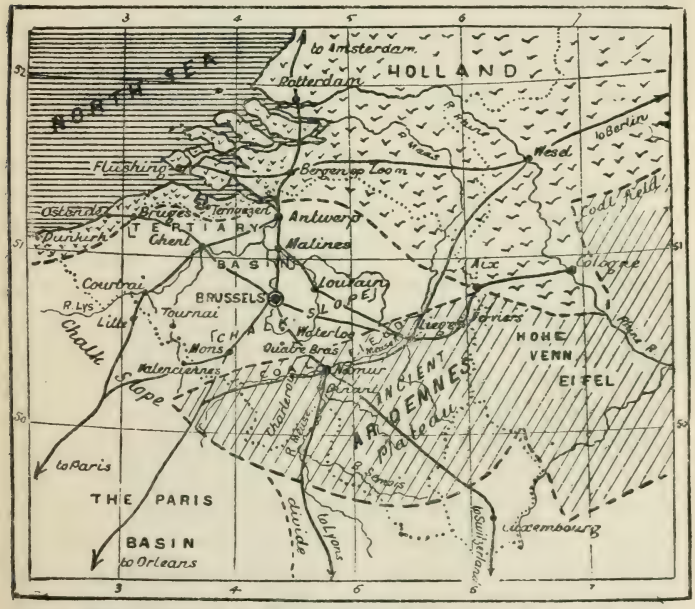


FIG. 220.—SKETCH MAP OF BELGIUM AND THE LOWER RHINE.

Plateau de Langres, close to the French Marne. It cuts through a beautiful zig-zag valley across the Ardennes table-land, and enters the Sambre-Meuse trough at Namur. The united streams flow along the trend valley of the Sambre under the name of the Meuse, which in Holland becomes Maas. The principal tributary streams of the Meuse, famous for the beauty of their deep valleys and limestone caves, are

the Ourthe, the Lesse and the Semois. The lower course of the Maas is again beyond the Dutch frontier and its mouth is closely associated with the many mouths of that greater river, the Rhine, to whose course the Meuse shows a striking parallelism.

The *lowland* basin of the Scheldt—Belgian Flanders—is famous for horses and for vegetable farms. Beet, rye and flax are grown.

The *upland* Ardennes region supports many sheep. The climate is similar to that of the south of England. As we should expect, the Ardennes, having an average elevation of 2.000 feet, receive more rain than Flanders and the seaboard.

The Belgian Coalfield.—The Sambre-Meuse depression contains one of the richest coalfields on the continent—a coalfield extending backward into France and forward into Germany. Zinc ores occur in the tableland and clay-ironstone on the coalfield. Hence the valley of the Meuse is the line of principal industries and densest population. But the lowland basin is almost as densely peopled. On the other hand the lovely pastoral country of the Ardennes, presenting many geological and geographical points of similarity with the Mendips of England (in the same latitude), is sparsely peopled. The density on the lowlands of the Scheldt and Lys may be set down to its once premier position as a weaving centre in Western Europe, together with its easy access to the coalfields and to the sea. Forming a watershed and cutting off the Meuse-trough from the Tertiary plain is a line of chalk hills continued from the Paris Basin to Maastricht.

Towns and Their Relation to Drainage-Lines.—Ghent is the focus, and Antwerp the gateway of Flemish trade. Liège is the commercial capital of the Meuse. Brussels, the political capital, foremost in the arts is the state-railway centre (Fig. 219).

The Scheldt and the Lys rise beyond the French frontier and unite at Ghent. The busy French town of Lille stands between their sources. Courtrai is on the upper Lys and

Tournai on the upper Scheldt. The battlefields of Oudenarde (1708) and Fontenoy (1745) are in the latter valley. Ghent is the centre of the cotton industry in Belgium, and has river, rail, and canal communications with Antwerp, Brussels, Liège, Bruges and Ostend. It has also its own port—Ternuezen—within Dutch territory at the mouth of the Scheldt, with which it is connected by ship canal. Before reaching Antwerp the Scheldt receives the waters of the Senne and its group of small streams from the chalk slope to the south-west. Brussels is the focus of the basin and of the kingdom. Many battlefields are scattered over

The Scheldt Basin.

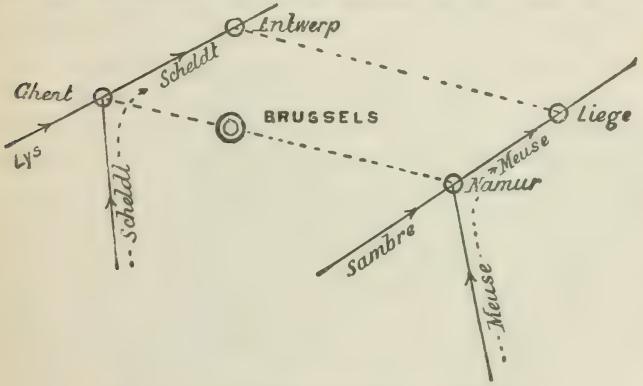


FIG. 221.—DRAINAGE LINES IN BELGIUM.

the slope. Quatre Bras (1815) and Waterloo (1815) lie due south of the capital. Mechlin (Flemish) or Malines (French) is a railway centre, famous for lace, and the seat of an archbishopric. Louvain is a university centre. Between the river and the coast are the decayed cities of Ypres, with its famous cloth hall, and Bruges (Flem. *Brugge*—bridges), a canal and railway centre between Ghent and Ostend. Ostend is the only considerable seaside resort (largely patronised by English visitors), and a packet-station for Dover, whence Belgian state steamers link English railways with those of the Belgian government.

The Meuse rises far back on the Plateau de Langres in France and within 20 miles of the headstreams of the Saone.

The Meuse Valley.

It flows along the axis of the limestone plateau, nearly due north, to Sedan, a historic town in connection with the Franco-German War (1871). Then it carves its way across the Ardennes Plateau, entering Belgium just below the French frontier fortress of Givet. From this point to Namur, the valley is exceedingly picturesque, as are also the tributary valleys of the Semois, the Lesse and the Ourthe, rivers which flow from the uplands. Caves of similar age and character to those of Cheddar and Matlock occur, and the Grotto of Han, in the valley of the Lesse, has a world-wide reputation. Dinant is the tourist centre. Namur stands at the confluence of the Meuse with the Sambre, which flows in remarkable parallelism to the rim of the Ardennes upland and is overlooked on its left bank by a low range of chalk. The valley of the Sambre and its continuation below Namur as the valley of the Meuse is a line of very dense population. Charleroi, Namur and Liège, in order on the stream, and in order as regards increase of importance, are the chief population centres in the valley. Verviers, a centre of the woollen industry, stands in a lateral valley, east of Liège, close to the German frontier, only 20 miles from Aix and 50 from Cologne. For some miles above and below Maastricht (Maas-ford) the Maas divides Belgian Limburg from Dutch Limburg, and then it flows in close parallelism with the Rhine and the Dutch frontier, eventually merging with the waterways of the Rhine delta.

The valleys of the Meuse and Sambre afford easy lines of railway communication between the Paris and Lyons basins and the German plain. Railway works of first importance occur at Liège. A transverse line, neglecting valleys, strikes from Brussels and Namur across the Ardennes plateau to Luxembourg and the upper German Rhine.

CHAPTER VII.

Holland (Wood-land).

APPROXIMATE CO-ORDINATES OF AMSTERDAM: $52\frac{1}{2}°$ N. $5°$ E.

THE flat low-lying country of Holland is the westward and seaward extremity of the Great European Plain, which slopes gently to the Baltic and North Sea depressions from the central European uplands. The peninsular and deltoid portions of the country are actually below sea level, and have to be protected by extensive and expensive dykes from the encroachment of the sea on the one hand and from the rising floods of the Rhine-Maas outlets on the other. Yet it is in this lowland area that the chief towns and the aggregation of population occur.

Geological Structure.—Holland, geologically, reproduces our English Fens and the flats of Holderness. Hence we shall notice a similarity in agriculture, industry and climate. The whole country is covered with recent gravels, alluvium and drift-clays. Its latitude corresponds to that of East Anglia. The shallow Zuyder Zee (South Sea—in contradistinction to North Sea) offers many points of resemblance to the English Wash. The *delta* of the Rhine-Maas streams faces the open *estuary* of the Thames. The Hook of Holland, the packet-station of peninsular Holland is opposite Harwich some 100

miles away, and Flushing, the packet-station of insular Holland sends daily steamers to Queenborough, on the Kent side of the Thames' mouth.

Climate.—Its climate corresponds to the medium type of the East of England. It is less rainy than the West of England but more rainy than any other portion of the Great Plain, across which rainfall decreases as we travel eastward to Moscow, *i.e.*, further from oceanic influence. The soil is damp, not so much from excess of rainfall as from its gravelly nature and from the absence of slope to carry off the water. Much pumping is necessary to render the soil, in the west, dry enough for cultivation. The work is performed by the many windmills so characteristic of Dutch landscape. The eastern frontier stands higher and therefore drains drier.

Agriculture and Other Activities.—Pasture farms are numerous. Cereals, such as wheat, barley and rye, flourish here as in every other part of the great plain. The growing of bulbs is a Dutch speciality. There are no minerals. Holland has held her own by her daring exploits at sea, her genius for colonisation, and by her trade with European countries in colonial produce. South Africa and the East Indies, as well as many parts of Australasia, were visited and developed in early times by Dutch settlers. The tropical produce of the East Indies finds its way in Dutch vessels through the gates of Rotterdam and Amsterdam to the various countries of the continent. Cotton and coffee are important imports. The low country between these two cities and from Utrecht to the coast is the most densely peopled area in Holland, rivalling Belgium and Saxony and Lombardy in the number of people to the square mile.

Towns and Communications.—The many mouths of the Lek-Waal-Maas complex are navigable to ocean-going vessels. Amsterdam has recovered her prosperity (partially lost to

Antwerp in the middle ages) by the construction of, first, the Helder and then the Haarlem ship-canal, bringing the city into touch with the open sea. Railways owned by the state connect the cities and strike towards the Rhine, or across the North German plain to Berlin. In addition to Rotterdam, the Rhine delta has quaint old Dordrecht (Dort) and the busy brewing-centre of Schiedam. The island which bears Flushing has also the ancient interior town of Middleburg, where spectacles were first invented.

Peninsular Holland has the pottery works of Delft, the fashionable state capital of The Hague, the ancient seats of learning and historic towns of Leyden and Utrecht (Oudetrecht—old ford) as well as the popular seaside resort of Scheveningen. Across the Amstel from Amsterdam are the sawmills and shipyards of Zaandam. To the south of the Amsterdam canal stands Haarlem, whose meer (or shallow lake) has been drained, the bed being converted into bulb-gardens. Alkmaar, on the peninsula, is the quaintest town in Holland.

North Holland rears many horses and cows, produces rye, barley and wheat, and finds a shipping outlet in the university town of Groningen. Some fisheries are carried on in the Zuyder Zee.

But Rotterdam's international transit-trade and the many industries of Amsterdam spell the prosperity of Holland.

CHAPTER VIII.

Germany.

APPROXIMATE CO-ORDINATES OF—

KÖLN: 7°E. / 51°N.

BERLIN: 13½°E. / 52½°N.

STRETCHING to the east of the Paris Basin and of Belgium and Holland is the consolidated empire of Germany, easily divided physically into High (or Upland) Germany and Low Germany (the North German Plain). The Empire extends north and south some 500 miles, with an average latitude of 51°N., similar to that of London; and the longest diagonal from Basel to Konigsberg, S.W. to N.E., is about 800 miles in length. This diagonal will be noted also as having some relation to the climatic belts of the country. Berlin, the capital of the Empire, stands in the centre of the northern plain in the same latitude as Birmingham and nearly 14° East of Greenwich. The area of the Empire is about 3½ times that of England and Wales. Three-fourths of Germany's coastline is along the Baltic, and liable to be frozen for three or four months in the year. The remainder is on the open ice-free North Sea (called also "The German Ocean"), and from its ice-free character important out of all proportion to its extent. Hamburg has grown to be the first among continental ports. Its estuary stands opposite the Yorkshire Humber, and is about 400 miles from Hull.

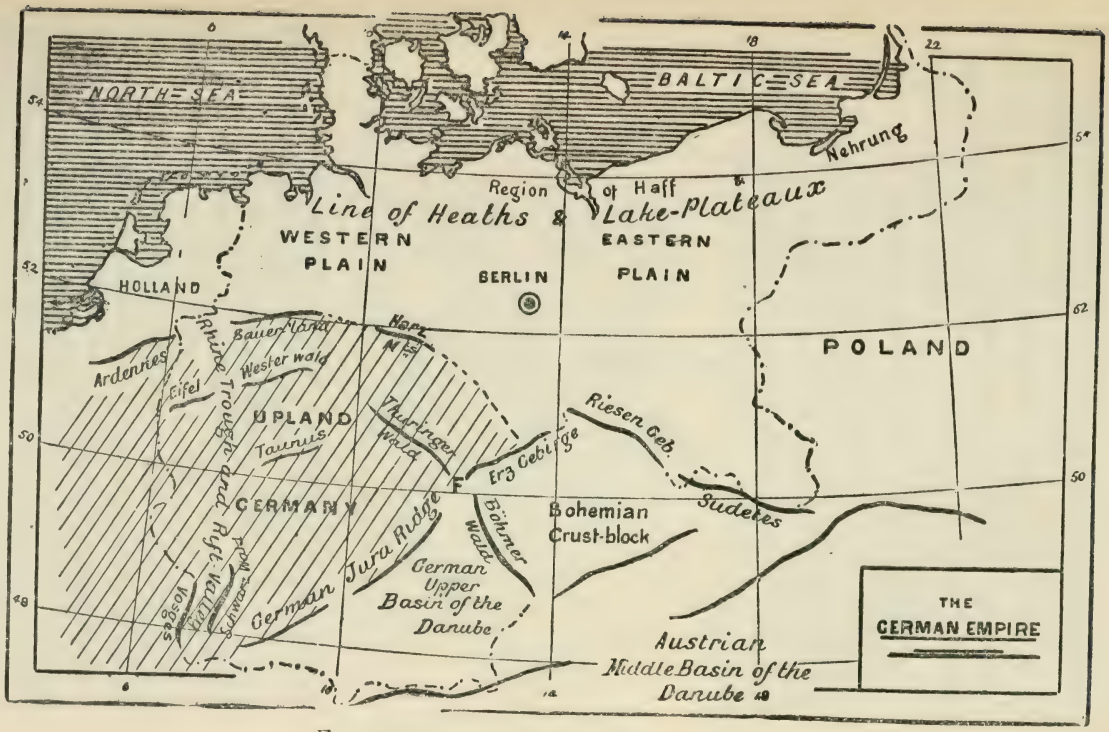


FIG. 222.—PHYSICAL FEATURES OF GERMANY.

Geological Structure.—*High Germany* merges into the Swiss Alpine Forelands beyond the frontier-marking Rhine on the south; it abuts on the Bohemian Crust-block to the east. The "horst" or saddle of the Vosges Mountains marks the frontier toward France, a frontier more important strategically than any other in the Empire and more strongly fortified. As the student will have begun to recognise, the uplands are mainly Primary or ancient geological formations of slaty type, either block tablelands like the Rhenish plateau and Bohemia, or folded axes, with cores of crystalline and granite rocks, like the Harz Mountains, which limit the upland region toward the

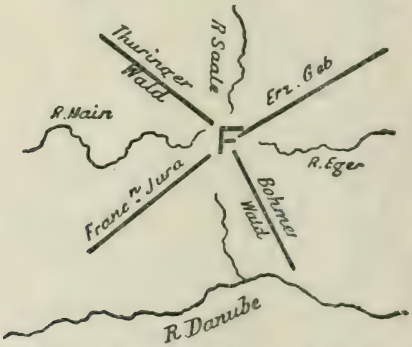


FIG. 223.—THE FICHTEL MASS AND ITS STREAMS.

German plain. Secondary rocks equal in age to our English New Red Sandstone occupy a considerable area in Germany between the Harz Mountains and the Danube depression, where they are flanked by the Secondary oolite ridges of the Swabian and Franconian Jura, which continue the Swiss Jura across the Rhine along the northern bank of the Danube. The *sandstone* type gives place to a soft shaly red rock, often rich in copper ores, and hence called Küpfer-Schiefer (copper-slates). The *oolite* ridges form a watershed between the Rhine streams and the Danube. Several groups of extinct volcanoes are scattered over the Rhenish plateau, especially

in the Eifel and the Wester-Wald (including the Sieben Gebirge, or seven mountains), of which the Drachenfels, or Dragon Rock, is best known to English tourists. The rim of the Bohemian block country forms the ranges of the Böhmerwald, the Fichtel Gebirge (or Fir Mountains), the Erz Gebirge (Ore Mountains), the Riesen Gebirge (Giant Mountains), and the Sudetes. From the core of the Fichtel Gebirge we note a radiate arrangement of ranges and streams.

The North German Plain continues the geology, climate and agriculture of Holland eastward, with some modification as we recede from oceanic influence. The whole is covered with a mantle of glacial deposits left by ice-sheets receding back on

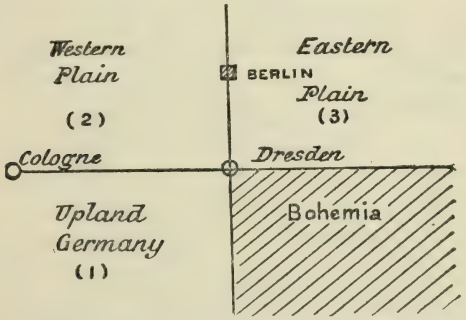


FIG. 224.—PHYSICAL DIVISIONS OF GERMANY.

the Scandinavian peninsula. The plain is really crossed from east to west by slight ridges, between which run shallow depressions. Such gentle undulation of the plain partly explains the remarkable parallelisms of main and tributary streams on the German lowland. Germany owns the larger part of the course of the Rhine and the head streams of the Danube. She contains the whole of the Weser and practically the whole of the *navigable* portion of the Elbe. The mouths of the Oder and Vistula are within German territory, as indeed is the entire *navigable* section of the former.

Climate.—Climatically, Germany is easily divided into three areas by the summer and winter isotherms :—

Upland Germany, in latitudes similar to those of the Paris basin, sheltered by highland frontiers, and sloping chiefly to the south or west, has a most genial climate, with an average winter temperature of 37° F. and a summer temperature of 70° F. Rainfall is considerable and comparable to that of the English Channel counties.

The western half of the North German plain is damper than the eastern half. As a result it experiences less range

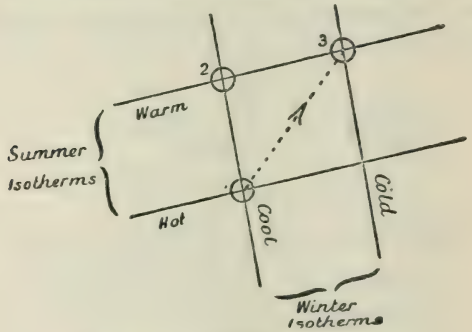


FIG. 225.—GERMAN ISOTHERMS.

of temperature (only 30° F. between the summer maximum of 65° F. and the winter minimum of 35° F.) and so offers resemblances to Holland. On the other hand, the eastern plain, with less rainfall, approximates to the more extreme Russian type, with a range of 42° F. between summer heat and winter cold (72° F. to 30° F.)

Fig. 225 shows the trend of the isotherms on the map of Germany. The three areas of the figure marked (1), (2) and (3) may well correspond with the three climatic divisions described above. (Compare Fig. 224.)

(1) Hot in summer and cool in winter.

(2) Warm in summer and cool in winter.

(3) Warm in summer and cold in winter.

The dotted barbed line runs from the region of greatest average heat to that of greatest average cold, and it roughly corresponds with the longest line that can be drawn across the German Empire.

Agriculture and Other Industries.—Germany is still an agricultural country in spite of her great advance into the front rank of manufacturing and mining countries, and pays much attention to the development of the land. Agricultural units not unnaturally correspond with the climatic units already discussed. The *southern upland* provinces are warm enough to allow the vine to flourish, and vineyards cover the sunny slopes of all the valleys. Tillage is only possible in the basins, and here wheat and hops are grown, especially in the basin of the German Danube, where the extensive cultivation of the hop has given rise to the brewing industries of Munich and of other Bavarian towns. The extensive *northern plain* is the chief seat of agricultural industry. Rye, oats, barley and wheat are grown. Some tobacco can be cultivated in the eastern half, with its hot summers. Recent years have seen the remarkable development of the beet-sugar industry, many thousands of acres on the plain being now given up to the growing of beet. Magdeburg and Halle, about midway between east and west, are the centres of the industry. Potatoes are largely grown and much potato-spirit is distilled. The spruce-fir extends further west than the Siberian fir. The former clothes many of the "Walds" of upland Germany. Oak and beech occur; and even the Spanish chestnut grows in the Vosges

Cattle-rearing is characteristic of every part of the plain; many geese are reared on the heaths and lake plateaux of the Baltic fringe, especially in Pomerania.

It is in the development of her mineral resources, and in the growth of industries springing therefrom, that Germany has made most rapid strides among European countries during the last thirty years. The border uplands, dividing High

Germany from Low Germany, are remarkably rich in useful metals and especially in silver, lead and zinc. The copper-slates of Thuringia yield much copper-ore. Lignite occurs in many of the "Walds," and coalfields fringe the highlands in the valley of the *Ruhr* (to the west) and in the valley of the upper (*Oder* to the east). An excellent coalfield is found also on the southern fringe of the Rhenish plateau, in the basin of the *Saar*, an affluent of the Mosel. Rock-salt and potash salts occur in association with the copper slates in the *N.R.S.* deposits.

Weaving industries are associated with the coalfields, where iron for machinery also abounds. *Cotton* goods are made in Alsace, close to the Saar coalfield, and also in Saxony around Chemnitz, where some coal occurs. *Silk* and *woollen* goods are manufactured in the Ruhr Basin and the frontier coal area of Aachen (Aix). *Glass* is a prominent manufacture in Germany, the sands of Aachen, Meissen in Saxony, and Jena in Thuringia being very suitable. Great *chemical works* have developed from the mining of the soda and potash salts in the Triassic rocks between Frankfort and the Harz.

Saxony, the Frankfort area, and the Lower German Rhine are thus the areas of dense population. The Rhine and the Elbe form their natural outlets, and railways parallel to the rivers help to cope with export and import traffic. Rotterdam (in Holland) and Hamburg are the gates of commerce.

Centres of Population.—Berlin is the focus of life on the great German plain, with easy access east, west, north and south by river and rail. Munich is the centre of the southern agricultural and beer-producing basin of the upper Danube. Dresden and Leipzic are the twin foci of Saxony. Strassburg in the upper Rhine valley, Frankfort-on-the-Main in mid-Rhine country, and Cologne at the point of emergence of the river upon the open plain are as hearts to the throbbing life of their densely peopled areas. Hamburg takes precedence among Germany's ports by her position at the mouth of the Elbe, where she has easy access to the open sea and to English coal.

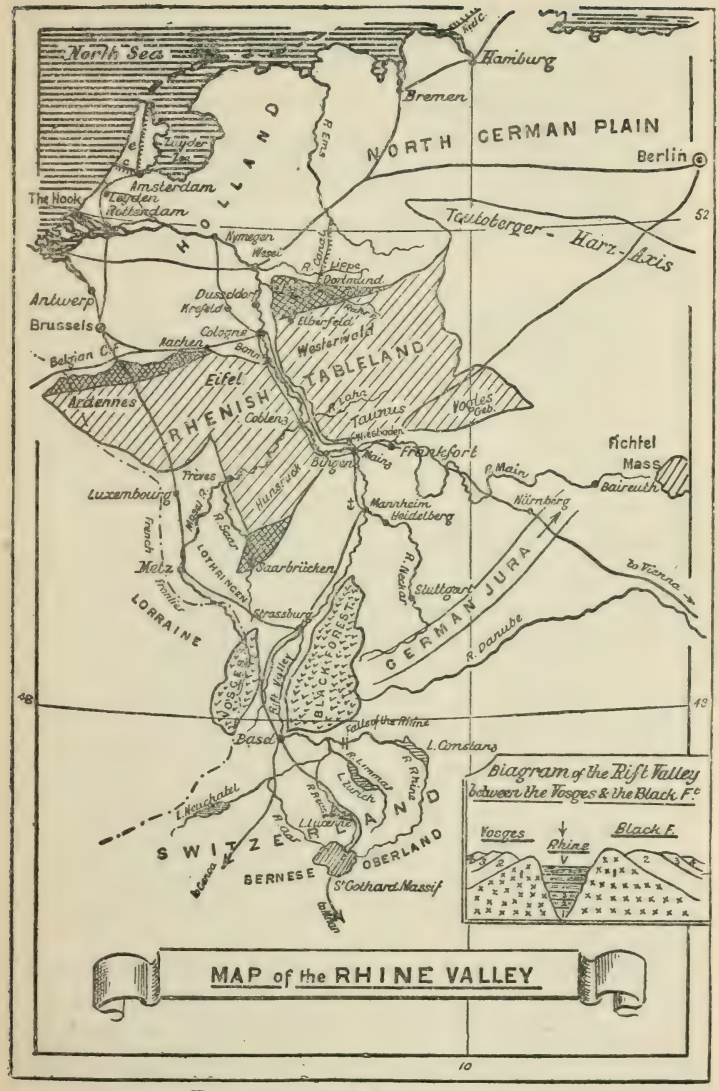


FIG. 226.—THE RHINE BASIN.

MAIN DIVISIONS OF GERMANY.—For the purpose of sketch maps and detailed consideration, Germany is conveniently divided as follows:—

(*a*) The German Rhine.

(*b*) The parallel valleys of the Elbe, Weser and Ems.

(*c*) The rivers of the German plain with Baltic outlets.

(*d*) The German Danube.

(The fourth of these will be considered with the Danube as a whole).

(*a*) **The German Rhine.**—The head-streams of the Rhine (the Vorder Rhein, Hinter Rhein, Limmat, Reuss and Aar), rise in close proximity, in glaciers around the central core or "massif" of the Bernese Oberland—St. Gotthard. They filter through the Lakes of Constanz, Zurich, Lucerne and Thun-Brienz before uniting above Basel, and just before entering Germany. From the lake of Constanz to Basel the main stream divides Switzerland from the German State of Bavaria. Basel is the northern gate of Switzerland, and important strategically as well as a focus of communication. The river is too fast-flowing here for navigation and liable to floods. But as a railway centre Basel is one of the most important stations on the continent. It has also some share in the cotton industry, which thrives in Alsace and in the towns of the Alpine Foreland. It stands just within the Swiss frontier. From Basel to Mannheim the head of navigation on the Rhine, the river flows in the rift valley let down between the two "horsts" or "saddles" of ancient granitic hills, familiar as the Vosges and the Schwarzwald (Fig. 226). The settling of the valley floor still goes on and earthquake shocks are not infrequent.

Parallel to the main stream runs the Ill, and between the two is carried a canal from the French river Doubs to the Rhine at Strassburg. The towns in this Alsatian trough stand on the Ill, to avoid the floods of the Rhine. Mülhausen (Millhouses) is a centre of cotton weaving. Another canal strikes

from the populous centre of Strassburg through a gap in the Vosges to Nancy, a centre of the iron industry within French territory. Carlsruhe is the only town of importance on the Black Forest side of the valley. The Wurtemburg stream of the Neckar rises near the source of the Danube in the south of the Black Forest, but finds its way northward along the foot of the range as far as the university town of Heidelberg, and then turns westward through the gap between the Schwarzwald and the Odenwald to join the Rhine at Mannheim. Between Mannheim and Bingen the valley opens out and receives the waters of the Main, which has made its zigzag course from the Fichtel Gebirge about two hundred miles to the east. Bayreuth, near the source, was the home of Wagner; Nürnberg, the city of Albert Dürer, in a branch valley, quaintest of German towns, and an important station on the Vienna line, has a speciality in the making of wooden clocks and toys. Frankfort stands where the Main emerges on the Rhenish plain. It is a fine city of half-a-million inhabitants, with splendid chemical and dye works, Mainz (or Mayence) is the confluence town. From Frankfort to Bingen the river skirts the foot of the Taunus plateau, famous for mineral springs. Wiesbaden is a centre of fashion and a health resort. Bingen stands at the upper entrance to the world-famed Rhine gorge. From this town to Coblenz the river cuts deeply into the ancient slaty plateau, leaving only room for a road and a railway on either bank. Here and there a pretty village like St. Goar or St. Goarhausen nestles under the scarp on a platform of rock. Coblenz is a handsome city at the meeting of the waters of the Mosel and the Lahn with those of the Rhine; it is overlooked from the east by the frowning fortress of Ehrenbreitstein, which held its own against Napoleon. Below Coblenz the valley opens out again to close in once more between Neuweid and Bonn, with the tableland of the Eifel, broken by numerous volcanoes, on the west, and the Westerwald on the east–another trough characterised by charming scenery. The university town of Bonn

and the seven volcanic peaks of the Sieben Gebirge stand at the lower end of the gorge. Henceforward the course of the wide and winding Rhine is across the "bay of Cologne," past the ancient and flourishing city, with its magnificent Dom, whose twin spires rise 550 feet above the crooked streets of the town. At Dusseldorf the river touches the western extremity of the Ruhr valley coalfield. Elberfeld and Barmen stand to the south of the Ruhr and share with Crefeld (to the west of the Rhine) in the cotton and silk industries of the area. Essen and Dortmund are situate north of the Ruhr; the former makes Krupp's guns and the latter is a coal-market. Below the confluence of the Ruhr, the highway of the Rhine is deflected westward to the deltoid plain of Holland, where it breaks up into distributaries, each capable of carrying ocean going vessels.

(*b*) **The Elbe, Weser, and Ems.**—Germany has three outlets on the North Sea, the estuaries of the Ems, the Weser and the Elbe. The *Ems* is a small stream, rising in the chalk basin between the Teutoberger Wald and the Ruhr coalfield. The Lippe, another river in this basin, finds its way to the Rhine at the important railway centre of Wesel. But the Ems, curving northward round the foot of the Teutoberg Forest, runs parallel to the frontier, and flows into the bay of Emden, which is the outlet port. The coal market of Dortmund on the busy Ruhr field has been linked by canal with the Ems, so that the coal-basin of Essen has now German communication with the open sea. This will lead to the development of the Ems and to a corresponding growth of Emden.

More important is the *Weser*, whose twin headstreams, the Werra and the Fulda, rise further back in the basalt plateau that links the Taunus and Westerwald of Rhineland with the Thuringian ridge, which runs westward from the Fichtel "massif." The Fulda and the Werra unite below Cassel to form the Weser, which escapes upon the German plain

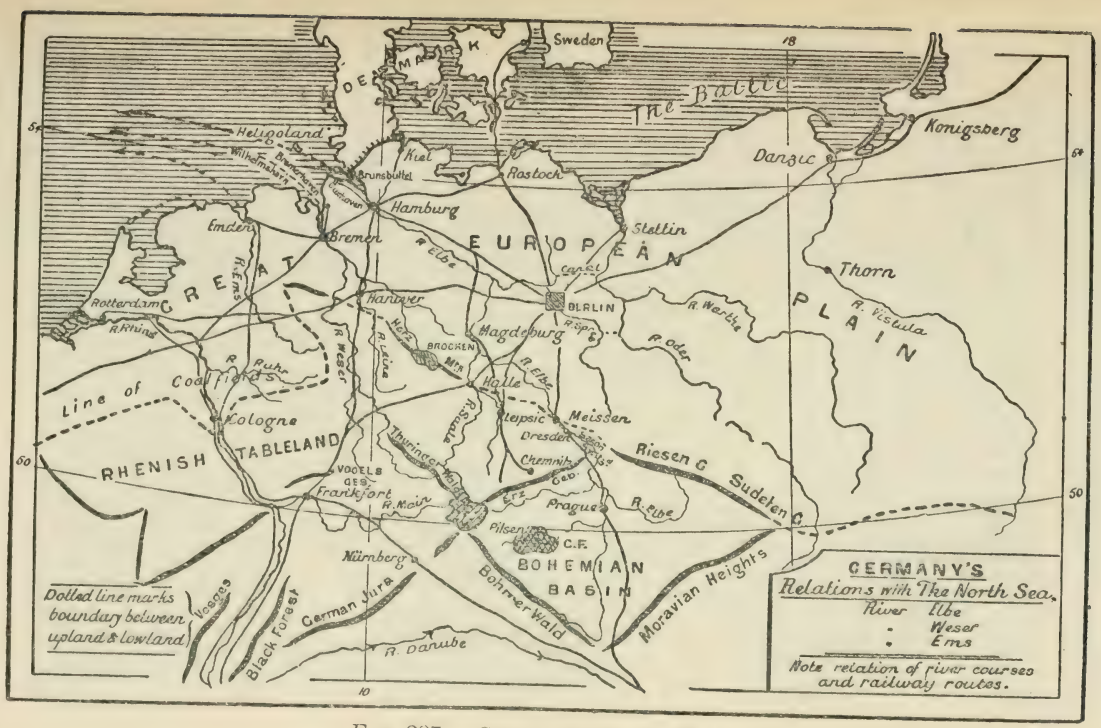


FIG. 227.—GERMAN LINES OF TRAFFIC.

through the gap between the Teutoberger axis and the Harz mountains, just below Hameln, the city of the "pied piper." The only considerable tributary of the Weser is the Aller, which, like the Weser, is formed by the union of twin streams—from opposite flanks of the Harz. The smaller stream, the Leine, rises in the "Brocken" mass, flows through the university town of Gottingen, and past Hanover, an important railway centre on the edge of the German plain. The main tributary, the Aller, flows parallel to the boundary of upland and plain, and after receiving the Leine, unites with the Weser about 25 miles above Bremen.

Bremen comes next to Hamburg in importance among German ports. It is the gateway of the Harz mining distr ct and the headquarters of the North German Lloyd steamers. Bremerhaven is its outport. Wilhemshaven, on a neighbouring bay is the naval base of the North Sea Fleet.

But first in importance among German rivers on the northern plain is the water-highway of the *Elbe*, navigable along its whole course over the plain and as far up-stream as Prague, the capital and centre of Bohemia.

The ancient basin of Bohemia, belonging to Austria, let down between the up-raised edges of the crust-block, contributes many radial streams to make the navigable Elbe.

The Elbe rises to the north, in the Riesen Gebirge (Giant mountains); the Moldau, on which Prague stands, more important than the Elbe, flows from the southern angle; the Beraun drains the coalfield of Pilsen, and the Eger comes from the mining districts of the Fichtel and Erz Gebirge, with the health resorts of Marienbad and Karlsbad in their upper valleys. The full stream finds its way through the gorge of tabular sandstone known as "Saxon Switzerland" into Saxony, the busiest of all the German provinces. The fine city of Dresden, with its treasures of art, stands at the lower end of the gorge, a few miles above the point at which the river emerges upon the

plain. Meissen, famous for Dresden china, has grown up at this point.

The aggregation of population in Saxony is chiefly between the Elbe and its tributary the Saale, on the Western border of the province. The mining and manufacturing centres of Chemnitz and Zwickau on the flanks of the Erz Gebirge (Ore mountains), and the busy basin of Leipsic, famous for its university, book trade, printing works, leather and fur market, fall within the angle made by these streams. The Saale itself taps the copper mining valleys of Thuringia. The ancient university town of Jena stands in a side valley. Erfurt, in the basin of Thuringia and Eisleben, at the eastern end of the Harz range, have interest in connection with Luther. Mansfeld, not far from the latter town, is the centre of the Harz mining industry. Halle, just below the point at which the Elster flows in from Leipsic, is the largest town on the Saale—a university town, with mining, weaving and brewing industries. Magdeburg, a few miles below the confluence of the Saale and Elbe, is the chief centre of the beet-sugar and brewing industries so characteristic of the lower basins of the Weser and Elbe. Along the trend-line of the lower Elbe is the Havel-Spree depression, which receives the Havel from the north and the Spree from the south and is infilled by many shallow lakes. The empire-city of Berlin stands on the Spree just above its junction with the Havel. Both streams are canalised so as to link the capital with the Elbe and the Oder and hence, with Hamburg and Stettin. Railways radiate to all parts of the Empire, to all the capitals of Europe, and to all the principal European ports. It is fitting that Hamburg should be at the outlet of this busy river. With Altona, Hamburg has a population of 932,100, It is served by the outport of Cuxhaven; and by means of the Kiel Ship Canal, whose North Sea gate of Brünsbuttel is at the mouth of the Elbe, it has easy access to the Baltic.

(*c*) **The Baltic Rivers of Germany.**—The eastern half of the North German plain is occupied by the two very similar rivers, the *Oder* and the *Vistula*. Both rise within the Austrian frontier, not far from each other and in the angle between the Sudeten Gebirge and the Little or Western Carpathians; both receive an important affluent on the right bank, the parallelism between the main streams being repeated in their affluents, Warthe and Bug; both flow over Tertiary and Recent formations to lagoon-like haffs, obstructed by tongues of sand-bank known as nehrungs, and given over to ice for about a third of the year. The *Niemen*, a Russian river further east, carries the parallelism further and empties by a German mouth at the corn-port of Memel. The ancient mass of Lysa Gora separates the upper basins of the streams.

Population is densest in the upper valleys, where mining and manufacturing are carried on. Troppau on the Oder and Cracow on the Vistula, both within Austrian territory, are the centres of population. Wieliczka, near the latter, has world-famed salt mines.

The *Oder* strikes north-west midway through the province of Silesia until, near its junction with the Warthe, it bends to the north. Breslau, the capital of Silesia, is a great manufacturing town and the focus of the coal and zinc mining industries of the Sudeten slope. Frankfurt-am-Oder is the agricultural centre of the basin and is linked by the Frederick William Canal with Berlin. The tributary Warthe drains from Poland through Posen. Stettin is the outlet, with its outport of Swinemunde. It is the port of Berlin, 100 miles away.

The *Vistula*, below Cracow, first forms the frontier of Poland and then curves across the rich basin of Poland past Warsaw, the capital, once important politically and now important because of its manufactures and position at the crossing of many railways. Lodz, between the Vistula and the

Warthe, has grown rapidly into importance as a manufacturing town (cotton goods chiefly) as the result of the discovery of coal beneath the Tertiary deposits. But Warsaw and Lodz are in Poland and belong to Russia. It is at Thorn that the river enters German territory, below which it bends at right angles to itself in trending to the Gulf of Danzic. One distributary flows into the Frisches Haff. The small river *Pregel* empties itself into this haff, and Königsberg stands at the mouth. Pillau is the outport. Danzic is the port of the Oder and is assisted by Hela on the sand-spit which stretches half across the gulf. The cargoes on these rivers include timber from the Austrian uplands, agricultural produce from the plains of Poland, Posen and Silesia, and goods interchanged with Breslau and Warsaw.

The Baltic coast is occupied by a lake plateau built out of morainic matter left by retreating Scandinavian glaciers of the Ice Age. This plateau now supports many geese and poultry farms.

Stettin, Danzic and Königsberg have sugar refineries and breweries, but as ports they cannot rival Hamburg and Bremen because they are hampered by ice in the winter months.

Kiel, in the western angle of the Baltic, is less troubled with ice and stands at the Baltic gate of the great Kaiser Wilhelm Ship Canal across the peninsula. It is the head-quarters of the Baltic Fleet, and has considerable trade in butter and dairy produce.

The island of Rügen is a favourite holiday centre for the people of Berlin.

CHAPTER IX.

Denmark.

APPROXIMATE CO-ORDINATES OF COPENHAGEN: $12\frac{1}{2}°$E., $55\frac{1}{2}°$N.

THE entrance to the Baltic is blocked by the fen-like peninsula and islands of Denmark, which constitute a northward projection of the North German Plain into the angle between the plateaux of Norway and of South Sweden. The Baltic is effectively cut off from the open North Sea with the result that its waters are less salt (since evaporation does not equal river-inflow), and it is, therefore, more liable to freeze. Moreover, the harbours are chiefly on the Baltic side of the peninsula (Jutland = Jute-land = Land of the Jutes), either on the turbulent Cattegat—cat's throat—or on the sounds which open to the Baltic.

Geological Structure.—The latitude of the country is roughly that of Scotland south of Inverness, Copenhagen ("merchants' haven") being nearly in the same latitude as Edinburgh. Quite unlike Scotland, however, in physical structure, Denmark recalls Holland and the English fens, the similarity being based on like geological conditions. Along the eastern edge of the mainland and islands, chalk crops out as in England and South Holland, and lends more variety to the scenery on the eastern coasts.

Climate and Produce.—Climate, too, varies east and west rather than north and south; the prevailing winds of warm

weather blow over from the west; winters are rigorous with a frozen Baltic and east winds blowing over it. Rainfall is about equal to that of our English east coast. No mountain wall taps the west winds, which carry storms across South Sweden towards St. Petersburg. The absence of metals and coal leaves Denmark a purely pastoral country but very prosperous owing to advanced methods of tillage and dairy-farming. Butter, eggs, cheese, horses and pigs are the principal exports. Peat is abundant on the peninsula and serves for fuel. Evidence is plentiful of the former existence of forests—especially of beech woods. Funen is the most fertile island. Nearly all the towns are ports for the despatch of agricultural produce.

Ports and Communications.—Copenhagen and Elsinore, on the main gateway to Baltic waters, have more than a local importance. Copenhagen, as large as Leeds, is the capital and the chief port. Originally it stood in the midst of the Danish Kingdom, which at one time included the southern portion of Sweden. Its fine situation, sheltered by an island, on the deep and direct channel of the Sound, has led to its prosperous development. Roskilde, in the island, was capital when Copenhagen was a village. Elsinore took the toll from ships using the Sound until 1859 when tolls ceased and Denmark was compensated. On the Swedish mainland stand Malmo and Helsingborg, opposite the two chief Danish towns. From Copenhagen railways strike west across the islands to the mainland, linked on the "belts" by steam ferries. Another line takes to the south, and its terminus on Falster is but 40 miles from Rostock on the German coast.

Odense (Odin's island), is the chief town in fertile Funen. It is famous as the birthplace of Hans Andersen. Korsor, on Zealand, is the ferry-town. Frederica, on the east, and Esbjerg, on the west coast of the mainland, are stations on the western railway from the capital.

Entering the peninsula from Kiel and Hamburg, the most important of Germany's representatives on the Baltic and

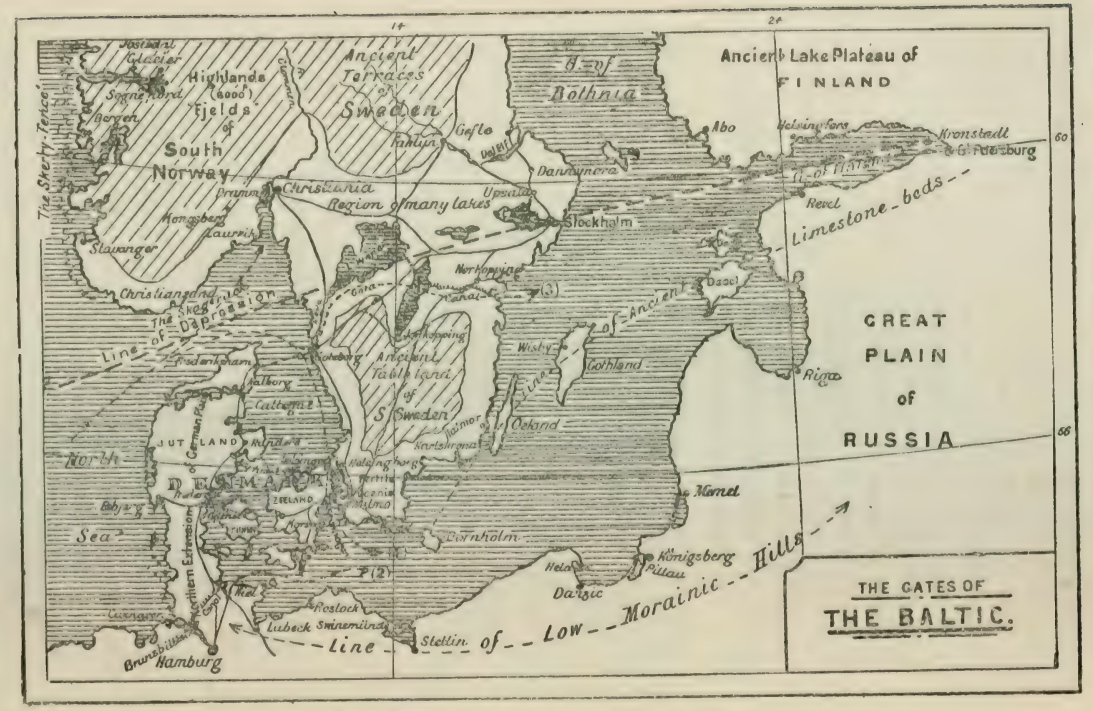


FIG. 228.—THE GATES OF THE BALTIC.

North Seas, a main line of railway follows the east coast rather than the west as far as Frederikshaven on the sandy Skaw.

Aarhuus, Randers (with glove factories), Aalborg, on the shallow "broad," known as Liim Fiord, and Frederikshaven, opposite the chief Swedish port of Göteborg, all share in the export of dairy produce and live stock.

Apart from Esbjerg, the open coast has no safe retreat for ships. Fogs prevail and, with sandstorms, make navigation dangerous. Much produce is now shipped from Esbjerg to Harwich for the London markets.

Linking the British Isles with Iceland and Greenland is the Wyville Thomson submarine plateau, so named after the discoverer. From this plateau rise the Faroe (sheep) islands, remnants of a former Tertiary basalt-outpouring. Politically they belong, like distant Iceland and Greenland, to the Kingdom of Denmark. Fishing, the gathering of eider-down and the keeping of sheep form the chief industries on these treeless islands.

Iceland, larger than Ireland, just outside the Arctic circle, is an inhospitable land, except on its southern fringe. Vast lava flows cover its surface, and many signs of decaying vulcanicity remain in the form of geysers. But where volcanoes have died out (Hecla is the largest and rivals Vesuvius) ice has appeared, and immense jokulls or icefields lie upon the basalts of the interior plateau, through which jagged peaks of bare rock emerge like the "nunataks" of colder Greenland. Reykjavik is the capital, but scarcely more than a village. The coastal sill facing south and influenced by the drift of Atlantic waters, yields crops for the sustenance of the scanty population. Fishing and whaling are the principal occupations of the men-folk. Some sulphur and Iceland-spar are exported.

CHAPTER X.

Scandinavia.

APPROXIMATE CO-ORDINATES OF—

CHRISTIANIA: 11°E., 60°N.

STOCKHOLM: 18°E., 59½N.

THE long axis of the Kiolen mountains, stretching through 10 degrees of latitude, descending steeply on the west to the deep Atlantic and by terraces on the east to the comparatively shallow Baltic, expanding southwards into the upland plateaux of the Dovre and Hardanger fjelds, is one of the oldest regions, if not *the* oldest, in Europe. Its steep slope, with innumerable "drowned valleys" or fjords, together with the ice-capped fjelds of the southern culmination form the kingdom of Norway. The forested terraces of the western slope, with many parallel streams draining through ribbon-lakes to the Bothnian depression, belong to Sweden. The sea-filled depression of the Skagerack, which separates Norway from Denmark, is represented by a chain of lakes in a land-depression across Sweden, dividing the southern low plateau of Gothland from the main and higher mass of the Kiolen range. This dividing trough is the line of greatest traffic and of the development of industry in Sweden.

The slopes of the plateau of south Sweden toward the Baltic are fertile and well cultivated.

North Sweden is little developed, owing largely to the rigour of its climate, and lumbering and mining are practically the only industries.

Norway is too mountainous to be of much use to agriculturists. The coasts of the Skagerack and the valley of the Glommen are the only available areas for tillage. Forests clothe the slopes of many fjords and some lumbering is done; but fishing, whether on the shoals and banks of the North Sea or among the polar ice, provides the chief means of subsistence to the Norwegian.

Out of the timber trade, paper and match industries are springing up in both countries, and many saw-mills are required, which cut the pitch-pine and deal to any size.

Climate.—Contrasted in slope, the two countries offer an even more striking contrast in climate. If any mountain wall in Europe may be called a climatic barrier, this wall of the Kiolen range, averaging 6,000 feet, and set at nearly right angles to the prevalent winds, is probably the most striking instance. A very marked "rain-shadow" area is the province of Norrland, in North Sweden, which lies under the wall of Scandinavia. Whereas the rainfall of Norway is equal to that of Ireland and the Highlands, that of Norrland is less than that of any part of Central Europe. The Spanish "meseta" alone can afford any comparison. Hence, while Norway is "equable," Norrland is continental (resembling Russia) in climatic type.

South Sweden has no obstructing mountain wall, and so its climate approximates to the North German type, with allowance for latitude and somewhat greater elevation.

Isotherms, both for summer and winter, run along the mountain axis, showing even in a more marked manner than in Denmark the east-west nature of the climatic changes.

No part of the Norwegian coast freezes during the winter, though North Cape is 5° within the Arctic Circle, and further north than the famous "North-West Passage." On the other hand, the coast of Norrland is ice-bound for nearly half the

year, making the ports idle; even the harbours of South Sweden, in latitudes between those of Aberdeen and Newcastle, are closed for many weeks in the depth of winter.

Trondhjem, 3° from the Arctic Circle, is as warm as Vienna in January; the North Cape is as warm as Astrakhan. On the other hand, the extreme north of Norrland is warmer than the Naze in summer. These facts illustrate the extremes of heat and cold to which Norrland is exposed and the temperating influence of ocean drift from the warm south-west, accompanied by rain-bearing winds.

Geological Structure.—Geologically, Scandinavia is the continental equivalent of our Scottish Grampians and Highlands. Crystalline rocks, granites, and allied plutonic rocks, form the huge mass of this ancient peninsula. By reason of their greater elevation, they still support numerous glaciers and icefields. In the Great Ice Age they were covered under an ice-cap, which descended upon the Baltic depression, mantling the North German plain with drift and boulder-clay. Traces of this drift remain on the uplands, and the Göta depression is infilled with it.

The chain of islands, rich in ancient limestones and quarried for marble, consisting of Bornholm, Oeland, Gothland, Dago and Oesel, is built of horizontal tabular strata, which are continued on the mainland as far as St. Petersburg. Bornholm remains to Denmark. Oeland and Gothland belong to Sweden. Dago and Oesel physically and politically belong to Russia. Wisby, on Gothland, is an old town and was a considerable port in the days of the Hanseatic League.

Metals.—As in Scotland, metalliferous ores are few. Kongsberg, a few miles back from the Christiania fjord, has silver mines. Excellent iron of the magnetic-ore variety (Fe_3O_4) occurs in the extreme south, and again in the extreme north of the Bothnian region. Dannemora steel has been famous for five centuries; Gellivara mountain, away near the

northern frontier, has been opened recently and is practically a mountain-pile of magnetite. Copper is worked around Fahlun. Coal is absent, except for a few seams in the extreme south corner of Scania.

Agriculture and Manufactures. — Agriculture and the industries springing from the timber trade—such as builders' carpentry, paper-mills, match-factories—engage the people of Sweden. Agriculture is profitable in the south ; wheat, barley, oats, rye, beet, and all the products of the German plain, are grown. Factories occur chiefly in the towns of the Göta depression, Jönköpping being famous for matches. Textiles are woven around Nörköpping. Steel works have grown up around Dannemora, and copper-smelting is carried on at Fahlun.

Population and Communications.—Upsala in the north of the populous areas, and Lund in the south, are universities for the Swedes. Railways converge on Stockholm, Göteborg and Malmo. The Sound and the canalized system of the lake depression are the lines of traffic.

Norway's population is aggregated in towns along the coast—centres of fishing or outlets for the export of timber, ores and building stones. Between the fjord-cleft coast and the open sea runs the "Skerry-Fence" of islands and rock-islets to the number of 150,000. Within the fence is a belt of sheltered waters in which the fishermen cast anchor.

The chief groups of islands are the Vigten and the Lofoten. Tromso, six degrees within the Arctic Circle, and therefore, in the "land of the midnight sun," is the northern fishing and whaling centre. Between the Lofotens and the mainland lies West Fiord, continued up into the heart of the hills as the Ofoten Fiord and then as the Ofoten Pass. The smaller group of the Vigten Islands lies just north of the fjord of Trondhjem (throne-home), once the capital of the Norse kingdom and still a cathedral city.

The favourite fjords of the tourist are the Sogne and the Hardanger inlets. Gudvangen, on the former, and Odde, on the latter, are popular centres. Bergen, only 200 miles due east of the Shetlands, is the headquarters of Norwegian fishing, and also the base of operations for tourists, lying as it does between these favourite fjords. Icefields and glaciers feed the torrents which fall over many ledges into the fjords. The largest ice-cap in the Old World is that of the Jostedals-Brae on the north side of the Sogne inlet.

Ports.—Gefle is the chief outlet of the Bothnian timber trade. Gellivara ore is now being exported from rising open ports on the Norwegian coast, whither a railway has been carried by way of the Ofoten Pass over the Kiolen ridge. Malmo, opposite Copenhagen, is the outlet of Scania. Trelleborg is the port for German trade.

Stockholm, the capital, built on "holms" or wooded islets at the entrance to Lake Maelar, must give place as a port to Gothenborg (Göteborg) at the ocean-end of the Göta and lake-canal system. Here is the main gate of Sweden's traffic with the outer world, on the stormy, but never frozen, Cattegat. Carlskrona is the headquarters of Sweden's navy. At Carlstad, on the northern shore of Lake Wener, the union between Sweden and Norway was dissolved (1905).

Towns and their Industries.—Stavanger, nearer the Naze, has also important fisheries of cod and herring as well as salmon. Christiansand is a popular resort. Laurvig exports excellent building-stone. Drammen has many saw-mills. Christiania is the capital and the outlet of the Glommen vale, practically the only inland basin in Norway. Silver is worked in the district around Kongsberg. The valley of the Glommen reaches back to a small lake within 50 miles of Trondhjem and from the divide another valley falls down to the ancient city. The railway takes advantage of these valleys in linking the old capital with the new.

Immediately beyond the "Skerry-Fence" the submarine platform suddenly drops to oceanic depths with no outlying archipelago.

The North Cape.—The bold island headland of the North Cape is but 19° from the undiscovered pole, yet always free from ice, except that which has toppled from the headlands on to the beach. The midsummer sun never sets for seventy-seven days and, of course, the midwinter sun never rises for a corresponding period. Hammerfest is the trading and tourist centre, whither many Lapps come, bringing furs.

CHAPTER XI.

European Russia.

APPROXIMATE CO-ORDINATES OF—

MOSCOW: 38°E., 56°N. ST. PETERSBURG: 30°E., 60°N.

THE empire of the Czar is continental in its dimensions. Russia-in-Europe, only one-fifth of the whole, has an area equal to all the rest of Europe, and no less than 30 times the area of England and Wales.

The vast empire is practically one great plain stretching from Arctic seas to the foot of the great mountain plateaux which run E.—W. across the Old World continent of Eurasia. The western frontier is but 20°E. of London; the eastern shore of the empire is, on an average, 120° further away, or one-third of the circumference of the earth in temperate latitudes.

The Ural Axis serves as a convenient boundary between the European and Asiatic portions of the Empire. The Caucasus wall limits Europe in the S.E.

The great plain of Russia is overlooked by four of the dominant ranges of Europe, and between these are the four outlets to seas or caravan routes indicated in Fig. 229.

Geological Structure.—The plain overlooked by these folded ranges is filled in with nearly horizontal strata resting on a crystalline floor. This rocky floor is exposed in the lake-

plateau of Finland in the N.E. corner. But south of the Finnish depression strata of successively more recent geological periods rest upon this floor, which is revealed only where rivers have cut through the sediments to this crystalline foundation. Coal-bearing strata lie concealed in Poland, south of Warsaw; and another coalfield of great size occurs around Tula, in the neighbourhood of the headstreams of the Oka and the Don. A very valuable coalfield outcrops in the valley of the Donetz, just north of the shallow sea of Azov.

The plain drains to four inland seas, and it is convenient

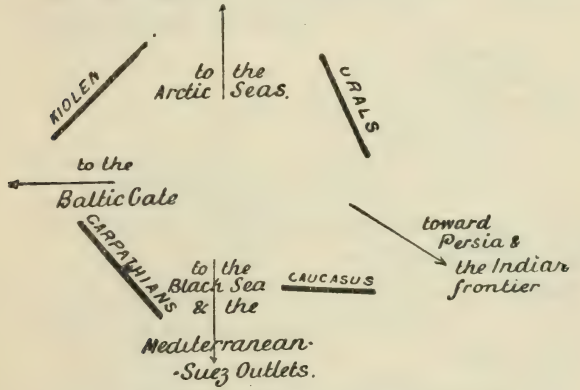


FIG. 229.—RUSSIAN OUTLETS.

from every point of view to divide the country into four geographical units as follows:—

1. Russia draining to the Baltic } Russia draining
2. „ „ „ Arctic } northwards.
3. „ „ „ Black Sea } Russia draining
4. „ „ „ Caspian Sea } southwards.

The N.W. quadrant is the oldest part of the land. The N.E. quadrant draining to the Arctic is largely covered with Secondary (Mesozoic) Rocks. The Black Sea drainage-area is the chief region of Tertiary rocks, which have been de-graded into the excellent black-earth (*chernozoum*) of the S.W. quad-

rant. The Caspian depression represents Russia's newest land, gravels and steppe lands, extending across the Manytch depression to the Sea of Azov and the Euxine coastal plain. The Valdai Hills, lower than our Pennines, represent the culmination of the plain and the focus of the watershed-lines.

The watersheds or "divides," however, are very feebly

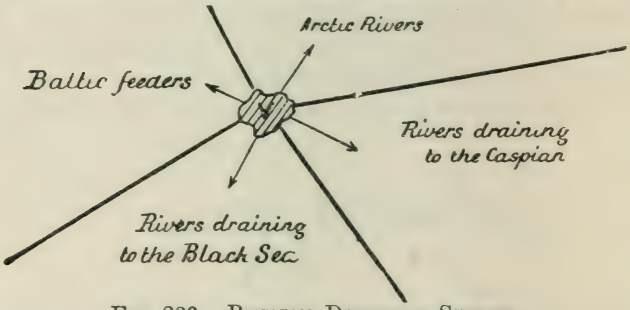


FIG. 230.—RUSSIAN DRAINAGE SYSTEM.

defined, and in many places are represented merely by ridge-lines of glacial débris.

Climate.—The four divisions roughly chosen correspond very strikingly with climatic provinces over the plain as determined by isothermal lines.

If we take note of the isotherms for four cities standing in the middle of the four climatic quadrants, we see that the east has greater extremes than the west, and the south greater extremes than the north.

The type of climate is everywhere continental, but extremely so in the Caspian depression. The greatest modification is where we should expect it, in the Baltic depression, open as it is to some oceanic influence *viâ* the North Sea and the Danish gates. Even here the range is 40°F., whereas the range at Killarney is but 15°F. (*i.e.*, of truly insular type). The small inset diagram is intended to indicate the diminishing continental character of the climate in the four

c	C
C	C

quadrants. If the reader bears in mind that isotherms are not precise climatic boundaries any more than are the Tropics of Cancer and Capricorn, or the Arctic and Antarctic Circles, but that the transition from one type to another is imperceptibly gradual, especially on an open plain, the foregoing division into climatic quadrants will be a help and not a snare.

Vegetation.—As climate is one of the chief determining factors in the vegetation of a country, it would be no great strain to carry the quadri-partite division even so far as to divide roughly the great Russian plain into:—

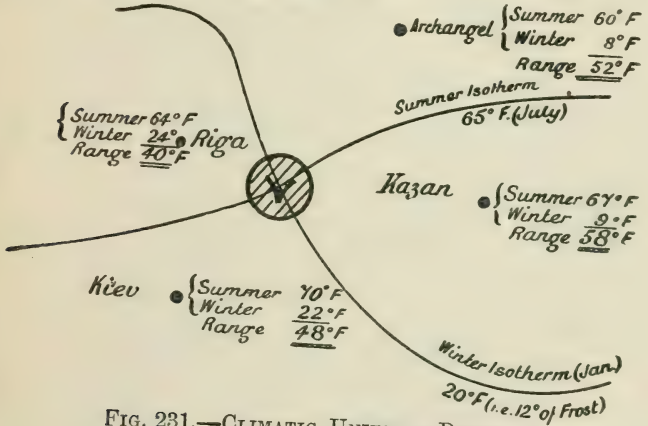


FIG. 231.—CLIMATIC UNITS IN RUSSIA.

1. The timber and grain lands of the Baltic.
2. The forest and fur lands of the Arctic.
3. The Black Earth region of wheat, flax, wool and wine.
4. The grassy steppes of the Caspian depression.
   (1) May be compared with the great lake region of the Canadian St. Lawrence, both geologically and climatically, as well as from the point of view of agriculture.
   (2) Recalls the industry and rigour of the "Lone Land," the Great North-West.

(3) Has its American representative in the Tertiary lands of Winnipeg and Minnesota.

(4) Offers many points of similarity with the prairies traversed by the Canadian Pacific Railway, though sheep are more numerous than horses.

FIG. 232.—CLIMATE AND PRODUCTIONS OF RUSSIA.

Industries.—Russia is essentially an agricultural country, but for many years her valuable mines of the precious metals (Platinum, Gold and Silver in the Ural axis) have been

worked as a source of profit to the government, whose prisoners were often compelled to labour therein. Of recent years the opening up of coalfields and the development of railway traffic have led to the growth of manufacturing industries.

The Tula coalfield in the centre of the country, and within reach of the political centre of Moscow, has many ironworks, and much railway-plant and rolling-stock are made, as well as firearms and cutlery.

The textile industries are progressing rapidly in Poland, around Warsaw and Lodz, so rapidly that Lodz, from a mere village has grown into a town the size of Bradford in half a century. The Donetz coalfield has led to the great strides made by the town of Kharkov. Coal can be carried by rail or river to all parts of the empire. The Finland towns, though distant from the coalfields, have developed textile and allied industries with great rapidity, and the manufactures of St. Petersburg are considerable.

The great *foci* of agricultural exchange are Kiev, in the Black Earth region of the Dnieper basin; Nijni Novgorod, the meeting place of East and West, on the Volga; Astrakhan, for the wool and tallow markets of the Khirghiz sheep steppes; Odessa, for the merino wool of the Black Sea coastal sheep-farms. Odessa is, moreover, Russia's chief port on the south. Nikolaiev and Kherson are additional outlets for the corn and wine and fruits of this fertile basin. Taganrog, at the head of the Sea of Azov, is an outlet for the steppe-lands, Astrakhan being shut in on an inland sea. Sevastopol serves as a naval base, and the headquarters of the Black Sea fleet.

Baltic and Arctic Ocean Ports.—North of the watershed, grain and timber find their way to the Baltic ports of Riga and Revel. Finnish iron (of the magnetite variety, Fe_3O_4) and timber are exported from Abo and Helsingfors. The trappers and the Lapps of Arctic Russia foregather at

Archangel, an ancient port and cathedral town. A new port on the Kola peninsula, Ekaterinsk, close to the Norwegian frontier is likely to interfere with the prosperity of Archangel, since its inlet is sufficiently influenced by the Atlantic drift to be free from ice all the year round.

Lines of Traffic.—Moscow is the old political centre, and still the "arterial" centre of the life-flow of European Russia. Railways diverge to all the points of the compass, and rapidly increase in mileage. With the opening up of the Tula ironworks came the necessity for more transit than the rivers of the great plain could afford. Main lines run to the ports on the four seas of Russia, and a trunk system carries the east-to-west European line from Berlin and the West through Warsaw and Moscow over the mining region of the Urals and forward across the rapidly increasing wheat farms of Siberia to the Pacific terminus of Vladivostok, and so brings Western civilisation into contact with the great Eastern nationalities of China and Japan.

Another line of development of traffic with the Asiatic interior, by caravan, and more recently by railway, is *vid* Samara, on the Volga, and Orenburg, on the Ural, towards the Hindu Koosh frontier of our Indian Empire. This is supplemented by a line of communication from the Black Sea at Poti, along the southern flank of the Caucasus to Baku, famed for petroleum, and then from the opposite Caspian shore, almost parallel to the Persian and Afghan frontiers.

The important city of Tiflis standing on the Poti-Baku Railway, is the university and political centre of the Caucasus. Following the track of the railway run pipes, carrying petroleum from the wells at Baku to the ships (specially fitted with oil-tanks) which load at Batoum.

CHAPTER XII.

The Danubian States.

APPROXIMATE CO-ORDINATES OF VIENNA: $\frac{16\frac{1}{2}°\text{E}}{48\frac{1}{4}°\text{N}}$.

WHILE Austrian Bohemia belongs physically to the basin of the German Elbe, German Bavaria belongs to the Danube, of whose basin the Empire of Austria-Hungary forms the middle and principal part. The free States of Roumania and Bulgaria form the basin of the lower Danube which serves to divide them. The unhappy state of hilly Servia sends most of its surplus waters *viâ* the Morava to the Danube.

The Upper Danube and Bavaria.—The main stream rises back in the ancient "horst" of the Black Forest, but a few miles from the Rhine rift-valley, and flows along the flank of the German Jura as far as Ratisbon where it is deflected by the obstruction of the Bohemian mass along the flank of the Böhmer-Bavar Forest to the Gorge between Passau and Linz just within Austrian territory.

Its Bavarian tributaries flow mostly from the south over the rich slope of the Alpine foreland. The Isar, "rolling rapidly" near the field of Hohenlinden, and the Inn, coming from the distant Tyrolese Alps and serving as a boundary in its lower course, are the principal affluents.

The fertile basin of Bavaria is famed for its corn and beer.

Ulm is the head of navigation. Augsburg and Ratisbon have historical interest in the struggles of the "Marlborough"

Wars, but Munich is the great modern focus of Bavarian life and industry. It has magnificent buildings, valuable art treasures, and a flourishing university. It stands first among German cities for the brewing of "lager."

The Middle Danube and the Austrian Empire.—The Tyrol, from which comes the Inn, is remarkable for its beauty, as yet but little explored by the tourist. Innsbruck makes an excellent centre, and the Brenner Pass leads over to the Italian valley of the Adige. A branch valley leads up past the salt-mining town of Salzburg to the picturesque region of the Salzkammergut now being opened up to exploring tourists, seeking fresh ground. Below the confluence of the Inn the course of the Danube is first between the Alps and the Bohemian ancient block-country, and then beyond Vienna across the small basin of Little Hungary, divided from the much larger basin of Hungary proper by the ridge of the Bakony Forest.

Linz stands in the Gorge of the Danube. The capital city of the Empire, Vienna, with one and a half million inhabitants, is situate some miles above the confluence of the Leitha (on the right bank) and the March (on the left bank) with the main stream. It is placed at the crossing of many lines of traffic—the Danube Gorge running E.-W., and the March-Leitha depression striking S.W.-N.E., and opening northward to the Russian plain.

The drainage-area of the March coincides practically with the busy manufacturing province of Moravia. Some coal is found. Excellent wool is produced. Textiles are the chief product of the factories of Brunn. Troppau, just within Austrian territory, has many woollen mills. The historic field of Austerlitz (1805) stands in the middle of the basin.

Below Pressburg the river is involved in shallows on the Little Hungarian Plain and navigation is hampered.

After following through a break in the Bakony Forest the Danube turns southward at Buda-Pesth, the capital of Hungary.

On the fertile Hungarian plain it receives its principal tributaries and grows to a river of majestic proportions,

FIG. 233.—THE BASIN OF THE DANUBE.

unspanned, except at two points by bridges, in each case carrying a railway. The basin yields the finest wheat in Europe and Szegedin is the agricultural centre. Potatoes and maize also flourish, especially in the south. The upper valley of the Theiss is steppe-like in character. Cattle and horses are reared in large numbers. Debreczin is the annual fair-ground. The volcanic soil of the head-valleys of the Theiss is favourable to vine-culture, and Tokay has considerable celebrity in wine-making.

The Maros, an affluent of the Theiss, comes from the forested tableland of Transylvania, which lies encircled by the Carpathian ridge. Oak and beech trees predominate. One province of the Carpathians on the trans-Carpathian side is actually called "the land of beech-trees"—Bukowina. The parallel streams of the Drave and Save flow in from the longitudinal valleys of the Austrian limestone Alps. These mountains contain valuable ores of iron and lead. Graz, on a tributary of the Drave, and Laibach on the Save are the mining centres. A railway from Vienna (using the Semmering Pass) links them with Fiume and Trieste.

In the angle of the plain between the Drave and the Danube lies the small coalfield of Fünf-kirchen.

The Lower Danube and the Balkan States.—The Save receives many tributaries from the hill countries to the south. Bosnia and Servia, the former subject to Austria and the latter an independent state, separated by one of these streams, have physical and agricultural features in common; fruit is plentiful in their valleys; oak and beech forests—on whose acorns large herds of swine are fed—cover the slopes.

The Morava gorge of Servia serves as an important line of communication and carries a trunk line from Belgrade *via* Nish, over the Balkans to Constantinople.

From Belgrade to the Iron Gate of the Carpathians, the Danube divides Servia from Hungary; henceforward it makes the boundary between the free states of Roumania and

Bulgaria until the river is deflected northward by the Dobruja limestone-plateau to the south of which the political boundary of these states strikes to the coast.

The line of the Danube represents the route of Mohammedan invasion of Europe. Gradually since the fifteenth century, state after state has freed itself from the rule of the Sultans until now a mere remnant of former conquests remains on the European side of the Bosphorus and Dardanelles.

Turkey proper is confined to an east-west strip of country between the Balkans and Olympus. The free states nearly all belong to the Danubian catchment-area. Even distant Montenegro sends its quota, though draining chiefly to the Adriatic.

Servia and Montenegro are of little importance; Belgrade, the capital of the former, has an unenviable notoriety from the many plots against its royal house. The capital of Montenegro, Cetigne, is a magnified village.

Roumania and Bulgaria, from their fertility and their situation on the banks of the mighty Danube, are states of considerable importance. The former is chiefly an alluvial plain backed by the Carpathian slope. Bulgaria has less alluvial plain and more terrace lands. Wheat and maize are the chief crops of the plain. The chalky terrace-lands of Bulgaria, and the charming garden of the upper Maritza valley in Eastern Roumelia (which politically belongs to Bulgaria, though cut off from the Danube by the Balkan watershed) are famed for roses and tobacco. Innumerable streams drain to the Danube from both states.

Widin and Rustchuk are river ports. Bukharest is the capital of Roumania. Galatz and Braila, at the head of the huge delta, control the traffic of the Danube; in the former town sits the Commission of all European nations responsible for keeping open the main channel of the ever-growing delta. Sofia, on the Bulgarian side, commands the principal pass over the Balkans, which culminate a few miles to the south in an

altitude of nearly 10,000 feet at the focus of the Rhodope Mountains. Philippopolis, between the Rhodopes and the Balkans, in the fertile basin of the Maritza, is the capital of Eastern Roumelia, which joined the free state of Bulgaria in 1885.

Varna is the port of Bulgaria and Burgas of Roumelia. Constanza (Kustenji), at the foot of the Dobruja plateau is the terminus of one trunk line from Buda Pesth, and has packet steamers for Constantinople.

The Peninsula of Istria.—The strip of limestone tableland which sends off many streams to the Save, but cuts off the Danube basin from the Adriatic, deserves special notice. The peninsula of Istria separates the bays of Trieste and Fiume, the two and only ports of Austria, connected by direct lines with Vienna and Buda, and giving the Austrian Empire access to the Mediterranean and to the gates of Gibraltar and Suez. Venice is but sixty miles away. Further south the tableland expands into the Karst, unique among European physical features. The limestone is so porous that nearly all the streams flow in underground channels along the clay bed next below. Some of these open out some distance from the coast, and the fresh water rises like a fountain through the salt seawater of the Adriatic. Many outlying islands fringe the coast. Fruits, like the olive and cherry, vines and mulberry-trees, are cultivated along this coastal strip.

Bohemia.—A consideration of the Austrian Empire leads us beyond the limits of the Danube basin. Bohemia, the most important province of Austria drains, as we have seen, to the German Elbe. It is an ancient crystalline "massif," whose rims form the rich mining districts of the Böhmer Wald, the Erz Gebirge, the Riesen Gebirge and the Sudetes. Between these the block has subsided along radial fractures, and sediments fill the basin. The rivers coalesce near Prague in the middle of the basin, and the Elbe escapes through a sandstone gorge into Saxony.

Along the Bohemian flank of the Erz Gebirge (ore mountains) are the mining-centre of Joachimsthal and the health resorts of Karlsbad and Marienbad. Pilsen stands in the middle of a coalfield, and has many weaving factories and "lager" breweries. Prague is the chief city and the focus of the basin.

If we continue the axis of the Sudetes to meet the Carpathian curve in the Beskid Mountains, we define the watershed between the March and the Oder and Vistula. Eastward of this divide, Austria includes the outer slope of the Carpathians towards the Russian plain. The sources of the Oder, Vistula and Dniester, as well as the Roumanian Pruth and Sereth (affluents of the Danube) all occur within Austrian territory. Along this strip of the empire an important line of communication has developed from Berlin and Breslau, through Cracow and Lemberg, to the Russian ports of the Black Sea.

CHAPTER XIII.

Switzerland—the "Playground of Europe."

APPROXIMATE CO-ORDINATES OF BERNE: $\frac{7\frac{1}{2}^\circ \text{ E.}}{47^\circ \text{ N.}}$

Geological Structure.—The high walls of the Pyrenees, Alps and Balkans shut off the plains and crust-block plateaux of Europe from the peninsulas of the Mediterranean. The average height of the mountain wall is 10,000 feet, so that it forms a striking climatic barrier, and before the days of engineering enterprise it effectually hindered commercial intercourse between the peninsulas and the northern plain. The Romans pushed beyond it by way of the Rhone depression on the west and the Danube basin on the east, as far as the great European rivers of the Rhine and the Danube, which marked the northern boundary of the Roman empire.

The Swiss Alps represent the maximum uplift, and Mont Blanc, within French territory, the culmination. The upland country of Switzerland, entirely devoid of coast-line, consists practically of the northern slopes and valleys of the Alps. It is in this region that crumpling and folding was greatest, thus corresponding with greatest uplift. The core of the Alps is Mount St. Gotthard, a crystalline massif, against which abut the almost parallel ranges of the Western Alps on the one hand and the Eastern Alps on the other. Down longitudinal valleys, between the ranges, flow the Reuss south-westward, and the Rhine, north-eastward.

The beautiful valley of the Engadine, drained by the Inn, is parallel to the Upper Rhine.

Apart from the mountainous Canton Ticino, Switzerland

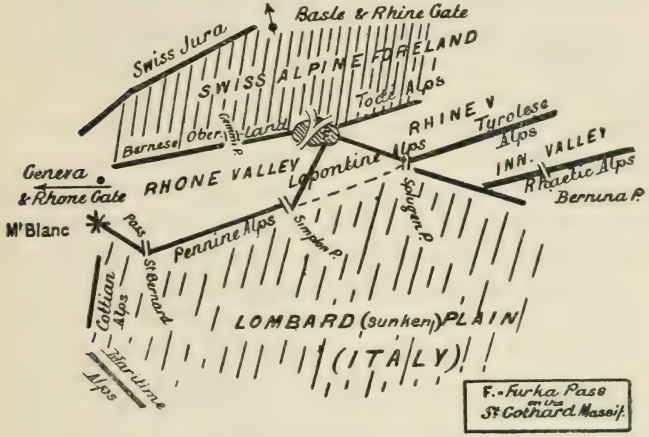


FIG. 234.—VALLEYS AND PASSES IN THE SWISS ALPS.

lies north of the Alpine wall, and includes the deep upper valleys of the Rhone, Rhine and Inn, together with the foreland of limestone Alps and sandy plateau, which run in parallel

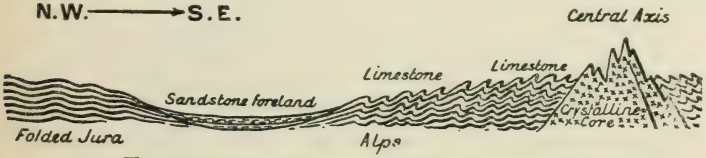


FIG. 235.—SECTION ACROSS SWITZERLAND.

belts across the country between the crumpled Alps and the symmetrically folded Jura ridges.

The ranges are named in Fig. 234.

Rivers.—All the principal streams rise in the St. Gotthard massif. In addition to the three already mentioned, the student must note the Aar and the Reuss, flowing northward

to join the Rhine, and the Ticino, descending southward to Lake Maggiore and the Lombard plain.

The Rhone encounters no lake until it filters itself in the majestic lake of Geneva, just on the fringe of the Alps and the frontier of Switzerland. The Rhine similarly filters through Lake Constanz, which rivals Lake Geneva in size and is situated on the German frontier.

The Aar traverses lakes Thun and Brienz, and, moreover, receives the surplus waters of two lakes in the Jura—Neuchâtel and Bienne. The Reuss brings the overflow of Lakes Lucerne and Zug, as the Limmat does that of Lake Zurich to the Aar, which some fifteen miles further down pours the whole drainage of the Alpine foreland into the Rhine at the German frontier. The Inn valley turns away from Switzerland and drains to the Danube.

Rainfall and Agriculture.—Rainfall is heavy on this upland country. Above the snow-line, snow replaces rain and accumulates, only to melt along its fringe, or, after conversion into ice by pressure, to be forced tongue-like down into the valleys, there to form the perennial sources of Swiss streams. Just below the snow-line the Alps are bare and comparatively useless. Mountain pastures are to be found on platforms of rock, and the valley slopes yield excellent grass. Tillage is uncommon. Most of the peasantry are occupied in dairy-farming and the exportation of cheese and condensed milk.

Manufactures.—Of mining there is none, the Alps being peculiarly deficient in mineral wealth. Manufactures play but a small part in the life of the country. Cotton mills, worked by water power, flourish in Canton Zurich. The watch making industry associated with Geneva employs many hands in the villages of the Jura, especially around La-Chaux-de-Fonds. Basel, at the gate to German Rhineland, and Geneva at the outlet toward France, are the two chief centres of traffic and communication with the outer world; Berne, the

official capital, stands on the Aar, where the river leaves the uplands for the plateau. Zurich is the focus of the cotton trade.

Railways and Passes.—The prosperity of these towns has been enhanced greatly by the opening of railway communication with Italy, and with the seaboard of the Mediterranean, by means of tunnels through the Alps. German trade, entering *viâ* Basel, can now reach Genoa and Venice, *viâ* the St. Gotthard and the Simplon Tunnels, the latter opened as recently as 1906. The passes (marked on the inserted map, Fig. 234) are now used chiefly by tourists in the summer, but deserted in the winter, when avalanches make them dangerous. The St. Gotthard Tunnel is used by a railway from Basel (*viâ* Olten) and a line from Munich (*viâ* the Reuss Valley), which unite at Lucerne. Thence the railway is carried along the shore of the lake, up the valley of the upper Reuss, piercing the mountain at Goeschenen, and reappearing at Airolo (ten miles), near the source of the Ticino, whose valley the line descends, branching to Turin and Genoa on the west, and to Milan and Venice on the east.

The Simplon Tunnel from the Rhone valley to Maggiore affords increased facility of transit to Italy and the Mediterranean.* But Switzerland is *facile princeps* among European countries for tourist and holiday-maker. Lucerne, Interlaken and Geneva are the chief centres. In more recent years tourists have ventured further afield, into the Ticino Valley, for Bellinzona and the Italian lakes, and into the Engadine and the Austrian Tyrol. From Lucerne, as a centre, may be explored the lake and its overlooking peaks, Pilatus and the Rigi.

Fluelen is at one end of the lake, and there is a steady ascent from there along the Reuss valley over the Devil's Bridge at Andermatt (with Goeschenen at the foot) as far as the Furka (=Fork) Pass (7,992 feet) which overlooks the Rhone Glacier on the other side. Near the source of the Rhone the

* The new **Lötschberg Tunnel** will link Kandersteg with Leuk in the Rhone Valley, affording a short route from Berne viâ Thun, Frutigen, Kandersteg, Leuk, Brieg, and the Simplon to the Plain of Lombardy.

road branches to the Grimsel Pass, connecting the Rhone valley with the Aar valley (the "main drain" of the Bernese Oberland).

The Bernese Oberland.—Interlaken stands on deltaic land which now cuts into two lakes (Thun and Brienz) what originally was one. It is the convenient centre for the Bernese Oberland, with its majestic peaks of Finsteraarhorn, Jungfrau and Wetterhorn, and the immense Aletsch glacier. Grindelwald is the mountain centre of the Oberland, and is reached by two railways from Interlaken.

The Upper Rhone Basin.—The western descent of the Furka passes the foot of the Rhone glacier, in which the river rises. The railway from Geneva has penetrated the Rhone Valley only as far as Brieg. At Visp it gives off a mountain railway to Zermatt, the paradise of Alpine climbers. Here, in the Pennine Alps, are the giants of the range—the Matterhorn and Monte Rosa at the eastern end; the Great St. Bernard and Mont Blanc (monarch of mountains) just over the French frontier at the western end. These latter may be approached from Martigny on the Swiss side, from Chamounix on the French side, and from the historically important valley of the Dora Baltea on the Italian side.

Lake Geneva.—Lac Léman, or Lake Geneva, the largest of the lakes, has many interesting towns and literary associations, especially along the northern shore. Rousseau, Gibbon and Calvin are recalled by the mention of Geneva. Byron has immortalised the Castle of Chillon. Lausanne is a prosperous town. Vevey has many dairy farms; Gruyères, just over the Oberland, has acquired fame for cheese.

The Jura Mountains.—The symmetrical Juras offer little attraction to the tourist. Yverdun, at the head of Lake Neuchâtel, has interest for teachers in the fact that Pestalozzi was master of a school here for twenty years, and Fröbel for a while shared his labours. An important railway skirts the Swiss flank of the Jura from Basel to Geneva.

CHAPTER XIV.

Peninsulas and Depressions of the Mediterranean.

AVERAGE LATITUDE, 40° N.

THE Basin of the Mediterranean is the most clearly defined physical and climatic region in the Old World. Apart from the rift-outlet at Gibraltar, it is entirely landlocked, although it extends for 2,300 miles into the interior of the Old World, a distance equal to the width of the North Atlantic.

The Mediterranean is very deep. Soundings reveal three basins in the one Mediterranean. The average depth is more than 5,000 feet in these hollows, and the enormous depth of 13,000 feet is sounded in the eastern basin. In these respects the Mediterranean differs from the Baltic, and from our own shallow North Sea, whose average is only 400 feet.

Moreover, the Mediterranean is shut off from the Great Plain of Europe by high mountain walls—the Pyrenees, the Alps, the Balkans; to the south it is open to the hot, dry deserts of North Africa. Oceanic influence breaks in where the land is low, at the Gulf of Lions and at Gibraltar; but this is insufficient to modify the very definite climatic conditions which exist in the basin. The western half of the basin, cut off from the eastern by the submarine ridge joining Sicily with Tunis, lies north of latitude 37° N., and the eastern basin lies south of this line, and gives off shallow arms to the north in the Adriatic and Ægean Seas.

The average distance in latitude from the Equator is thus only 37° N., or about 15½° outside the Tropics. The sun's rays have less obliquity than for countries in higher latitudes, and the difference between summer and winter is less pronounced. These facts, coupled with the fact that land masses, so susceptible to heat, enclose the basin, account for the high average temperature of the Mediterranean (65° F. annual average), a temperature equal to that of the Southern States of America. The southward projecting peninsulas (as the closed isotherms show) are the hottest lands in Europe. The Sahara, almost immediately to the south, is one of the hottest regions in the world; and when the *Sirocco* blows from it to the Mediterranean, a season of uncomfortably hot weather is experienced. The mountains cut off the cold, winterly winds from N. and E., so that the annual range of temperature is not more than 25°F.

Mediterranean Peninsulas { 80°F. Summer. 55°F. Winter (equal to English Summer). 25°F. Range (annual).

As a result of high average temperature, evaporation is great, and the waters are of more than average saltness, leading to a surface inflow at Gibraltar. The Mediterranean, so utterly landlocked, is practically uninfluenced by the oceanic tidal wave. Hence the rivers—the Rhone, the Po, and the Nile—have built up huge deltas. The islands of the Mediterranean are upstanding, ancient blocks of folded character. Between them and the peninsulas long continued subsidence has given rise to deep sea-basins. The Balearic Islands project from the coast of Spain, while Corsica, Sardinia and Sicily enclose the Tyrrhenian Sea. Crete and a number of smaller islands divide the Ægean arm from the eastern trough.

Rainfall is considerable, except on the Spanish "meseta," though, of course, the western Atlantic-facing slopes are more rainy than the eastern valleys and plains. The soils of the Mediterranean valleys and plains are mostly of Tertiary and

FIG. 236.—THE MEDITERRANEAN

Recent origin, and are of great fertility. A warm climate, sufficient rainfall, and excellent soil, combine to make the basin one of the most fruitful in the world. Climatically, productively and historically, the African fringe and the European peninsulas form one geographical region. Currants and raisins, the vine and the olive, the orange and the pomegranate, rice and tobacco, the banana and the date-palm, some sugar and cotton are grown.

Ores and coal are but poorly represented. the mining regions of Spain and Turkey being remote from the basin. Silver-lead ores do, however, occur on the Mediterranean side of the Sierra Nevada. Elba has excellent iron-ore. Greece and Italy have excellent marbles. The volcanic Italian border of the Tyrrhenian Sea has valuable deposits of sulphur. Manufactures fall far behind agriculture, and are confined practically to Barcelona and the basin of the Po.

The Mediterranean was the *Orbis veteribus notus* of the Romans. It has formed the arena of the rise and fall of notable civilisations, first that of the Phœnicians, then that of the Greeks, and later still the Roman Empire. The advance of Mohammedan races from Asia was chiefly to the North of the Mediterranean region along the course of the Danube.

The middle peninsula now takes the lead in prosperity and civilisation. Greece is small and its mountains isolate its people. The Christian native in the Balkan Peninsula is under the heel of Mohammedan rule. Spain has many resources, but is in a backward state of civilisation. Italy, free and united, is advancing to the front rank among European peoples.

CHAPTER XV.

The Balkan Peninsula.

APPROXIMATE CO-ORDINATES OF CONSTANTINOPLE: 29°E. / 41°N.

THE core of the Balkan peninsula is in Shardagh. Thence radiate the ancient crystalline axes of the Balkans, the

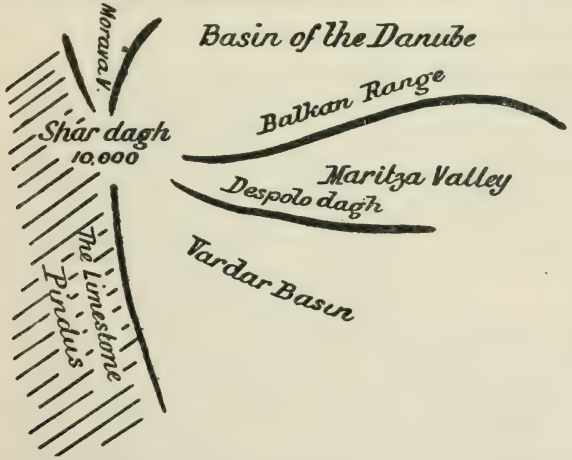


FIG. 237.—THE RADIATION OF RANGES IN THE BALKAN PENINSULA.

Despotodagh and the Olympian mountains of Macedonia, which extend into Greek territory.

The limestone range of the Pindus continues the Dalmatian

(Karst) type of country along the flanks of the older mass. Greece is predominantly a limestone country, though Cape Matapan and other headlands are crystalline.

The angles between the crystalline axes are fertile basins filled with Tertiary and Recent rocks. Chief among these, south of the Balkans, is the rich valley of the Maritza, the upper half of which forms Eastern Roumelia and belongs politically to the free state of Bulgaria. Turkey proper, that which is left of all the Mohammedan conquests in Europe, is practically confined to the belt of country south of the line of the Despotodagh, and extending from the Adriatic to Constantinople. Much of it is too mountainous and wild to support population; it is in the valleys and on the coastal fringe that towns are found. The climate is sub-tropical; agriculture flourishes with little industry. Roses yield the famous "attar of roses." Mediterranean fruits abound. Rice and tobacco thrive on the damper soils.

Turkish Towns.—Constantinople stands at the end of the "dagh" which shuts off the Maritza from the Black Sea. Built around the Golden Horn of the Bosphorus it is unrivalled among European capitals for beauty of situation. Stamboul is the Turkish quarter. Pera and Galata are the European quarters. Scutari is on the Asiatic side of the narrow Bosphorus. The combined population exceeds a million and a quarter. Constantinople was long the Eastern capital of the Romans, and commemorates in its name one of their emperors. Philippopolis, celebrating Philip, the father of Alexander the Great (of Greece), and Adrianople, named after Hadrian (of Rome), are the principal cities in the Maritza basin. Gallipoli, on the ridge of land which shuts in the narrow channel (4 miles wide) of the Dardanelles, exports olive oil.

The trans-continental line from Vienna and Belgrade crosses the mountains by way of the pass near Sofia, and sends off a line *viâ* the Maritza Valley to Constantinople, and another to Salonica by way of the Vardar basin. Salonica is a busy

port, though most of its sailors are foreigners. It exports the produce of the valley and the coast.

The Adriatic coast has a mild climate, but little population. The off-lying island of Corfu is Greek territory. Italy is but fifty miles away across the Strait of Otranto.

Greece.—Greece occupies the hilly peninsula south of Lat. 40°N. It is almost cut in two by the fjord-like Gulf of Corinth. Indeed, the mountain wall has been cut through by a canal at Isthmia (which gives us "isthmus") and so the severance is complete. The plain of Pharsalia and the plain of Thebes, shut in by the wall of the Olympus range and its continuation in the island of Negropont (joined by a bridge to the mainland) are the fertile regions of Northern Greece.

Corinth, which gives its name to the gulf and to the isthmus, is linked by rail with Patras on the west and "fair Athens" on the east. Athens, the first city of the Greeks in their golden age, remains the capital of the modern kingdom. It has many memorials of its past grandeur in its temples and groves and sculpture. Piræus, eight miles away, serves as its port. The battlefield of Marathon (490 B.C.) lies over the hill N.E. of Athens. Patras has large export trade in fruits. At Missolonghi Byron died. The Ionian Islands, which cluster around the entrance to the Gulf of Corinth, enjoy a delightful climate and export Mediterranean fruits.

The Morea (so-called because of its mulberry form), formerly known as the Peloponnesus, is an irregular mountainous mass of limestone built upon a crystalline foundation. Its irregular form and hilly interior have isolated its towns and retarded its development. Hence Greek towns in olden times were more or less independent states. Intercourse is by water rather than by land. Olympia, Sparta and Argos have ancient renown. Navarino saw the decisive battle in which England, France and Russia secured the freedom of Greece from the tyranny of the Turk (1827).

Cape Matapan is the most southerly point on the mainland of Europe.

The Ægean Sea is full of islands, two groups of which, the Cyclades and the Sporades ("scattered"), belong to Greece. The remainder were prosperous Greek colonies in the days of the Empire. Troy stood on the mainland near the entrance to the Dardanelles. The long mountain-walled island of Crete, enjoying since 1898 autonomous government under a Greek prince, has all its harbours on the north.

CHAPTER XVI.

The Italian Peninsula and Islands.

APPROXIMATE CO-ORDINATES OF ROME: $\frac{12\frac{1}{2}°\text{E.}}{42°\text{N.}}$

Physical Characteristics.—Apart from the plain of Lombardy, Italy is essentially a system of mountain ranges. The steep face of the Alps overlooks the plain from the north and the west and sends many streams to feed the axial stream of the basin, the Po. Three of these drain through beautiful lakes before emerging on the plain—the Ticino through Lake Maggiore, the Adda through Lake Como, and the Mincio through Lake Garda. The whole basin is a sunken trough covered with alluvial deposits and glacial ridges. It is excelled nowhere in Europe for fertility. This, together with its fine climate, has led to its development into the most populous region in the Mediterranean area.

Peninsular Italy consists of the axis of the Limestone Appennines, culminating in the Gran Sasso d'Italia (9580 ft.) and presenting its steeper slope to the Adriatic in the northern half, and to the Sicilian waters in the southern half of the peninsula. The older rocks emerge in the peninsula of Calabria, and in the opposite promontory across the rift-strait of Messina. The west of Corsica and the east of Sardinia belong to the same formation, being remnants left by the sinking of the ancient Tyrrhenian crust-block.

The borders of this depression remain so unstable that seismic and volcanic disturbances are still characteristic of this, as of no other, region of Europe. The Tyrrhenian border of the peninsula affords better harbours than the Adriatic.

Rainfall increases as we pass from Sardinia to Italy and across the Adriatic to Dalmatia. The east of Sardinia and

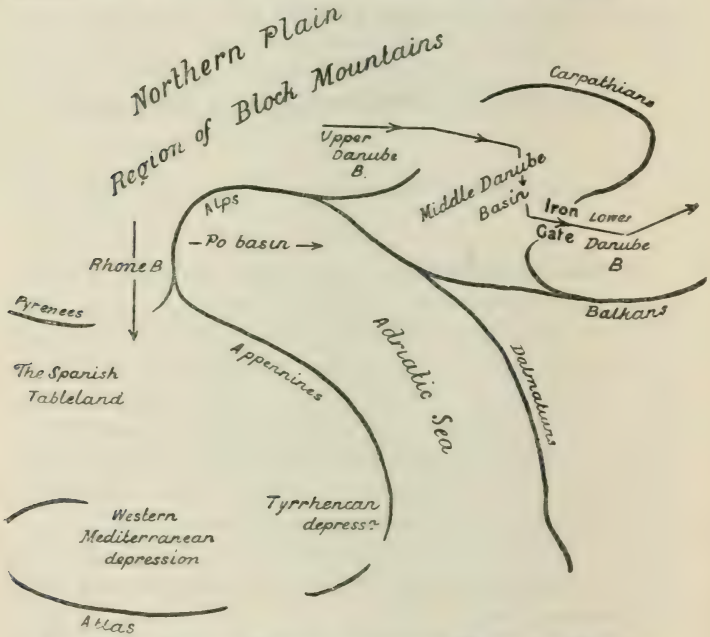


FIG. 238.—FOLDED RANGES AND THEIR ENCLOSED BASINS.

the malarial plains around Monte Gargano are "rain-shadow" areas. Temperature is comparatively high, but especially so in the south. Sicily has an average temperature of 65° F.

(a) **The Basin of the Po and the Adriatic Depression.**—The Po is the dominant river of Italy. It drains the slopes of Piedmont and the fertile plain of Lombardy. It receives innumerable tributaries from both the Alps and the Appennines

and carries a tremendous load of detritus down to its delta, which pushes out to sea at a greater rate than any other known delta. Adria, which gave its name to the sea, is now about 20 miles within the delta. For navigation the Po is of little value, but its floods have fertilised the plain, and now irrigation is organised on a large scale, avoiding floods and renewing soils. The banking-in of the river and the filling-up of its bed have gone on to such an extent that now the roofs of the houses in Ferrara are below the level of the river.

Turin, Milan and Venice are the three great cities of this densely-peopled plain.

Turin, in the centre of Piedmont, is the capital and the focus of industry in the province. Wool from the sheep-farms on the slopes is extensively woven in Turin. Silk is also manufactured. Railways give access to Genoa (the nearest and Italy's greatest seaport) to Lyons and France by the Cenis Tunnel, to Milan and North Europe by the St. Gotthard, and to the North by the Simplon Tunnels (1906). Before the days of railways, the valley of the Dora Baltea and the Great St. Bernard Pass, giving access to the Rhone valley, were largely used. A main line follows the axis of the basin on the north side of the river to Venice.

Milan has a fine position, midway between the rivers Ticino and Adda, which come from the Italian lakes. It is the first city of importance reached by rail through the Simplon and St. Gotthard Tunnels, and owes much of its modern prosperity to their opening. It is world-famed for its cathedral. Silk predominates over wool in its manufactures.

Venice, once the political rival of Milan, is built on islands north of the delta of the Po. No words are needed to describe its charm. It has long been famous for its glass industry, and the associated industries of pottery and mosaic work. In the days of the Republic, it was the "mistress of the Mediterranean," and the focus of Europe's trade with the East.

The fertile plain of Lombardy owes more of its wealth to

agriculture than to manufactures. The latter have always been hampered by lack of coal.

Alessandria, a busy railway centre; Pavia, the birthplace of Volta; Cremona, famed for its violins; Mantua, the home of Virgil; Verona and Padua, Parma and Bologna, are towns in this thickly-populated basin. Rice, an exceptional crop in Europe, grows abundantly on the plain. The railway, linking Turin with Parma and Bologna, skirts the shores of the Adriatic to the distant port of Otranto, at the gate of the Adriatic. Ancona and Brindisi are the chief places of call. From the latter P. and O. steamers start for Suez and the East, though the removal of much of this company's fleet to Marseilles has lessened its importance.

(b) **The Gulf of Genoa and the Tyrrhenian Depression.**—The western flank of the Appennine range has a greater importance than the Adriatic slope. In Liguria the Appennines approach the sea. Genoa has a magnificent situation, and is a formidable rival of Marseilles on the west and Venice on the Adriatic. Much German traffic passes through this port, having come *viâ* the Alpine tunnels. Spezzia is a naval station. The charming valley of the Arno has Florence—the "queen" of Italian cities, and the home of Dante, the Medicis, and Savonarola—at its upper end and Pisa and Leghorn at its lower end. Pisa is famed for its leaning tower. Leghorn has a straw-plait industry. The valley exports olive oil in "Florence" flasks.

The Tiber, the "yellow" Tiber of the Romans, rises within a few miles of the Arno, but empties itself into the sea at a point 170 miles away from Leghorn. The intervening coastal plain is marshy and thinly peopled. Deaths from malaria amount to thousands annually. The Island of Elba, from which Napoleon escaped, lies off the coast. It yields valuable iron-ore. Civita Vecchia is a naval station. Rome is built on seven hills, some twenty miles away from the mouth of the Tiber. The stream is yellow, owing to the large quantity

of limestone detritus carried down from the easily-crumbled Appennines. No description is needed of Rome's great past and remaining memorials. None would be adequate.

Larger than Genoa, Florence or Rome, is Naples, the chief town in the southern half of the peninsula.

In spite of volcanic dangers, it has grown to be one of the

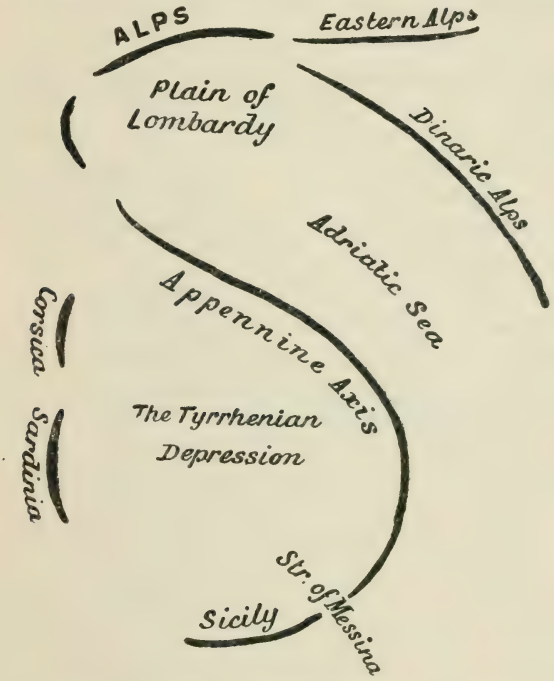


FIG. 239.—THE ITALIAN RANGES AND BASINS.

chief ports on the Mediterranean. Vesuvius stands across the bay, and at its foot Herculaneum and Pompeii have been revealed by the removal of the volcanic débris which overwhelmed them in the Vesuvian eruption of 79 A.D. The Tyrrhenian Sea is deep and its waters are warm. Corals thrive. Sardine fisheries employ many people. The eastern edge is

dotted with many volcanic islands—Ischia, Stromboli (the "lighthouse" of the Mediterranean) and the Lipari group being among those best known.

The Island of Sicily is separated from the geologically similar peninsula of Calabria by the Strait of Messina, which fills a rift formed in Tertiary geologic time. Messina had great importance in the ancient Greek empire. The huge volcanic pile of Etna, with a base more than ninety miles in circumference, rises to a height of 10,780 feet. Sulphur is exported from many of the valleys and rifts on the sides of the volcano.

Palermo, on the north coast, is the capital of the island, magnificent for situation. Marsala on the west and Girgenti on the south trade with Africa (especially Tunis), which is, at the narrowest place, only 100 miles away. The ruins of Carthage stand on the Bay of Tunis.

Catania serves the east coast. Syracuse has fallen back from its leading position in the days of the Grecian Empire.

Sardinia is of little political or commercial importance. Granite and iron ores are plentiful, but little worked. Cagliari has fisheries and trades with Tunis.

CHAPTER XVII.

The Iberian Peninsula—Spain and Portugal.

CO-ORDINATES OF:—

GIBRALTAR: 5¼°W., 36°N.

LISBON: 9°W., 39°N.

MADRID: 3½°W., 40½°N.

THE Iberian Peninsula, so named after the Iberians who early peopled it, is the most westerly of the Mediterranean lands. Portugal and the adjoining regions of Spain belong rather to the Atlantic border than to the Mediterranean fringe. The compact form of the country corresponds with its block structure. The Peninsula is a crust-block of ancient rocks, covered on its Mediterranean side with more recent deposits, and squeezed in between two systems of folded ranges, the Pyrenees on the north and the Sierra Nevada on the south. Subsidences of segments of the block give the V-shaped valleys of the Ebro (at the foot of the Pyrenees, and draining toward the Mediterranean), and the Guadalquivir, (at the northern base of the Sierra Nevada, draining toward the Atlantic). It is in these basins and along the coastal sill that the fertile "huertas," or "gardens" of the peninsula are found.

Parallel rivers, cutting deep into the plateau, drain westward to the Atlantic shore, separated from each other by

corresponding ridges which traverse the plateau. The Minho is short, and drains a mountainous district rich in iron-ores. The Douro valley opens out into a basin around Valladolid, from which is exported at Oporto the famous port wine of the basin. The basin closes in on reaching the Portuguese frontier and thenceforward the Douro traverses a gorge in granite hills.

The Tagus has no upper fertile basin, but crosses the exposed tableland (average altitude 2,000 ft.), and after cutting through a similar gorge, opens out on the Tertiary coastal strip

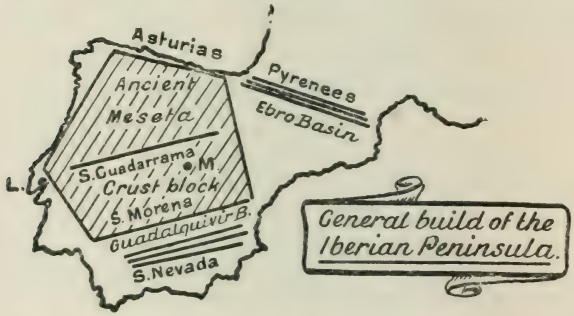


FIG. 240.—STRUCTURE OF THE IBERIAN PENINSULA.

on the south side of the Cintra range into the fine estuary known as the Sea of Straw, on which Lisbon stands.

The two capitals of the Iberian peninsula are situate on or near this river. Madrid stands in the centre of the tableland, on a small affluent, and Lisbon on the coast.

The Guadiana follows a similar course across the plateau, but on entering Portugal is deflected southward so that indeed its estuary forms the frontier.

Rainfall and Temperature.—The tableland is as cold as Ireland in January and as hot as Egypt in the summer months. Rainfall thereon is low, especially in the east. Sheep-rearing is an important industry. The rocky coasts of the north-western

angle are the rainiest, since in this region the rain-winds drive in from the Atlantic most often from the north-west (Fig. 241).

The Pyrenees, too, intercept the rain-winds, and are exceptionally wet. The basins shut in by mountain walls are comparatively dry, and, therefore, suitable to grain and fruits. The Guadalquivir basin, fertile Andalusia, is famous for its horses.

Mineral Wealth.—We have noted already that the rims of ancient crust-blocks are often rich in metallic ores, and the Spanish "meseta" furnishes an example. Iron-ores are common

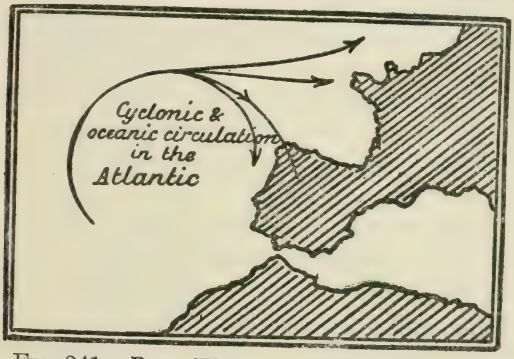


FIG. 241.—RAIN WINDS OF S.-W. EUROPE.

and coal is plentiful along the Asturias border. Copper ores are valuable in the valley of the Tinto. Quicksilver ores are found in the Sierra Morena. Silver and lead occur in the Sierra Nevada. But the Pyrenees resemble the Alps in this as in many points—they are poor in metallic ores.

Mining is in a backward state, though the export of iron and coal from Bilbao and Gijon (Biscay), of copper from Huelva (S.W.), and of quicksilver from Almaden (in the valley of the Guadiana) is considerable.

Industries.—Agriculture is the chief occupation of the people. The vine flourishes in the basins with the result that we get port from the Douro valley, Sherry (Xeres) from

Andalusia, and Tarragona port from the Ebro region (exported from Tarragona). Oranges are largely grown around Seville in the Guadalquivir basin and exported, with sherry, from Cadiz (the Roman Gades). The Mediterranean gardens or "huertas" require and repay irrigation. Rice, maize, the sugar-cane and all Mediterranean fruits will readily grow. Malaga and Valencia are the chief centres of export for south and east. Almeria and Alicante share in the trade.

Barcelona, Spain's largest town on the Mediterranean, is a busy manufacturing town, the chief textile being cotton. The vicinity is famous for nuts.

Saragossa is the only large town in the Ebro depression. The steep wall of the Pyrenees looks southward to the basin.

Granada, standing back from the plain of Andalusia and at the northern foot of the Nevada (snowy) range, is the old capital of the Moors, whose memorial remains to this day in the Alhambra (the red) palace.

Lisbon and Oporto are the gates of the Portuguese trade. Portugal, still a maritime power, owes much of her prosperity to the shipping of Oporto and Lisbon. Wheat, rye and maize are grown in addition to the vine.

Madrid is the capital of Spain, but Valladolid and Toledo have older historic associations. Santander and Bilbao are the chief outlets of the Biscayan coast.

Gibraltar, the gate and key of the Mediterranean, after many vicissitudes, became a British Possession in 1704. The town stands on a jutting rock on the eastern (or inner) side of Cape Tarifa. Cape Tarifa is but twelve miles from the opposite African coast of Morocco. Ferrol, on the N.W. coast, and Cartagena at the S.E. end of the diagonal, are Spanish naval bases for Atlantic and Mediterranean waters respectively.

The off-lying islands of Iviza, Majorca and Minorca, which form the Balearic group of the Mediterranean are generally considered to be detached extensions of the folded

system of the Sierra Nevada. Lying off the Atlantic coast, and (unlike the Balearic Isles of the Mediterranean) physically independent of the peninsula, are the Azores and Madeira, true oceanic islands, possessions of Portugal. The Canary Islands, however, belonging to Spain, are physical outliers of the African continent. All are used as ports of call for Atlantic vessels.

Railways.—Railways enter the peninsula at the two ends of the Pyrenean wall. The western line proceeds to Valladolid and Madrid, giving off a branch to the Ebro valley. The eastern line skirts the Mediterranean coast with stations at Barcelona and Valencia. From central Madrid lines radiate to all the principal towns of the peninsula.

Questions on the Historical Geography of Europe.

(*Based on Forbes'* "CONCISE HISTORY OF EUROPE.")

1. Trace the relation of the *Roman Empire* to the Mediterranean basin; also indicate its physical frontiers beyond the Alps.

2. Explain the phrase "Africa begins at the Pyrenees."

3. Describe the development of commerce and cities in the Baltic countries under the *Hanseatic League.*

4. Show what an important part the cities of the *Italian* peninsula took in the civilisation and trade of the fifteenth and sixteenth centuries.

5. Trace the routes of the *Moorish* and *Mohammedan* invasions of Europe from Africa and Asia respectively, and indicate what permanent memorials remain of these invasions.

6. What countries took the lead in exploration and discovery during the age of the *Renaissance?* What were the principal European ports at that time?

7. Show how religious persecution led to the migration of industries from one area to another.

8. Trace the vicissitudes of the following cities:—Constantinople, Rome, Moscow, Florence, Geneva.

9. Locate the following historic places:—Hastings, Morgarten, Worms, Nantes, Ryswick, Austerlitz, Jena, Leipzic, Waterloo, Navarino, Sevastopol, Sedan.

10. Note the relation between *physical* feature and *political* frontier in Europe to-day.

Exercises on the Map of Europe.

1. *The student should be able to estimate roughly the area of a river basin or of a province, if a map* with a scale *is given to him.*

The outline of the province is marked. In the case of a river basin it is necessary to draw the boundary of the basin by reference to lines of drainage.

When the area to be measured is defined, it should be

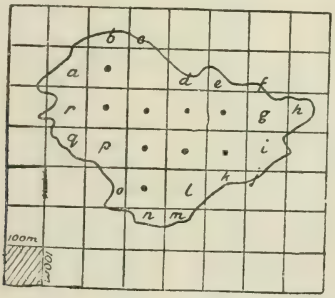


FIG. 242.—EXERCISE IN AREA-MEASUREMENT.

covered with squares of $\frac{1}{10}$ in. side Then, by taking the sum of the whole squares and fractions (approximately estimated) included within the irregular area, say :—

9 whole squares $+ a + b + c + d + e + \ldots$

$= 19{\cdot}3$ whole squares.

Suppose 1 in. = 4 miles, then $\frac{1}{10}$ in. = $\frac{4}{10}$ ml.

Area of one whole square = $\frac{4}{10} \times \frac{4}{10} = \frac{16}{100} = {\cdot}16$ sq. mls.

" river basin $= 19{\cdot}3 \ldots \times {\cdot}16$ sq. mls.

If transparent squared paper is available, the basin may be traced thereon.* Thick lines lead to inaccurate results. Estimates may be tested by reference to a cyclopædia.

2. On the map of Europe trace the 1,000 feet line of contour (altitude) of land above sea-level. also the 100 fathom and 1,000 fathom lines in the European seas.

3. On a blank map of Europe insert:—

(*a*) the folded mountain ranges.

(*b*) the general courses of the Rhine, Danube, Volga.

(*c*) the chief wheat-growing regions, wine-producing districts, forest-belts.

(*d*) the isotherms which pass over the British Isles.

(*e*) the five greatest cities and their means of communication.

(*f*) the principal ports on each sea.

(*g*) the general direction of Atlantic oceanic drift and oceanic winds.

(*h*) the regions of exceptionally heavy and exceptionally low rainfall.

4. *An exercise in comparison of areas.*—Find in round numbers the areas of Great Britain, France, Germany and Russia. Compare with cyclopædia. (*See* Fig. 243.)

In this diagram we have a graphic comparison of the respective areas of Russia, Germany, France and Great Britain. Each square has a 100-mile side, and, therefore, an area of $(100 \times 100) = 10{,}000$ square miles.

* Excellent transparent squared paper may be had from Messrs. Jackson, Armley, Leeds; or Stanford's Long Acre, London.

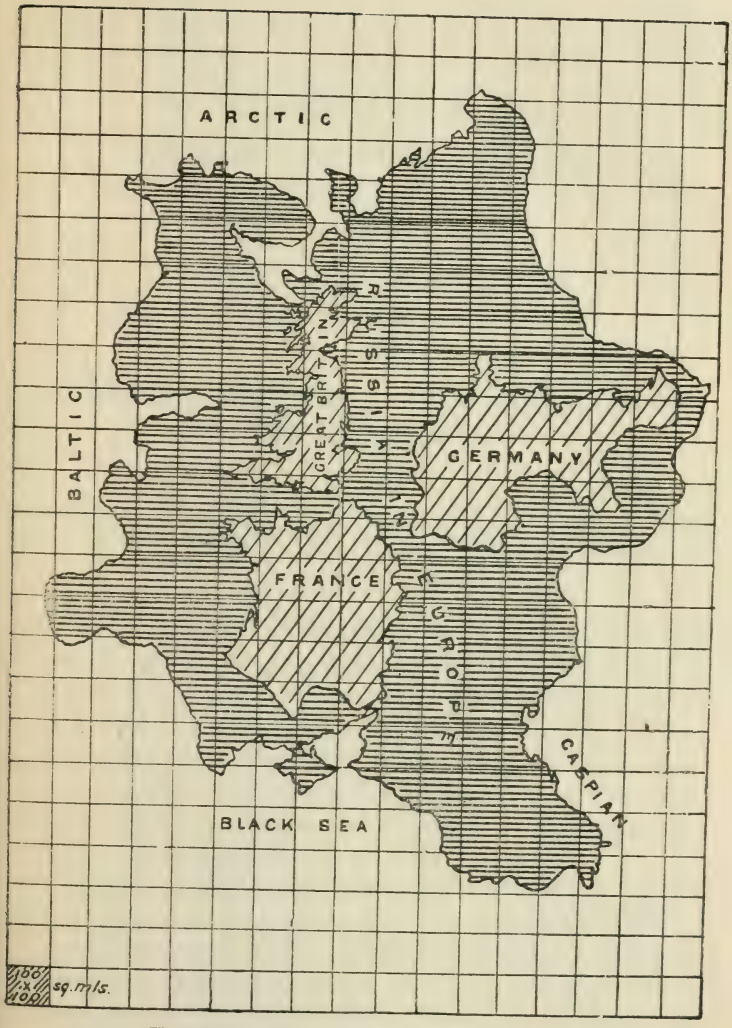


FIG. 243.—COMPARATIVE AREAS.

GEOGRAPHY OF NORTH AMERICA.

PART I.

GENERAL CONSIDERATIONS.

CHAPTER I.

World Position, Discovery and Development.

[Maps to be studied: Terrestrial Globe; The World in Hemispheres; Mercator's Map of the World; Map of the Land Hemisphere.]

Discovery and Development.—The North American continent—so closely associated with English-speaking peoples that they refer to it as America simply—rivals the smaller continent of Europe in its advanced state of civilisation, and in the rapid progress of its communities. If we neglect the visits of the Northmen, by way of Iceland and Greenland, to the inhospitable shores of Labrador, we may say that until some four hundred years ago it was an unknown continent.

Columbus touched the West Indies in 1492, the *Cabots* gained the mainland in 1497, and *Cortez* reached California by way of Cape Horn in 1535; thirty years later the Spaniards, who had settled on many of the coastlands and islands of the South American continent, made their first settlement on the northern continent in the peninsula of Florida.

Religious persecution in the European countries, following upon the unsettling and disturbing movements of the

Renaissance and the Reformation, drove many to seek a new home in the newly-discovered continent. *French refugees*, attracted at first by the fishing grounds, penetrated the hitherto "dark continent" by way of the St. Lawrence and the Mississippi, along whose valleys they have left their traces in the names of towns, streams and states. To this day the dominant population of the lower St. Lawrence is French. British navigators, as far back as the sixteenth century, dreamed of a *North-West Passage*, but no explorer was able to steer his vessel along the entire passage until 1906, and then the feat was accomplished by a Norwegian (Captain Amundsen). But the dream led the British to explore and colonise Canada rather than the more southerly parts of the continent, where the influence of Spain was great and her naval power was strong. *Raleigh* and *Drake*, full of the adventurous spirit, ventured southward, in the year before the sailing of the Armada, as far as latitude 35 N., exploring the coastlands of what now are the states of Virginia (so-called in honour of Queen Elizabeth) and the Carolinas.

But colonisation on any systematic scale followed only after the death of Elizabeth and the close of the Tudor period. In the first ten years of the seventeenth century the *French*, who had explored the region in 1535, founded Quebec, and by 1615 had penetrated to Lake Superior. *Jesuit missionaries* were chiefly instrumental in the advance.

Puritan families from England and Holland sailed in the Mayflower in 1620 and established the first British colony, naming it Plymouth, after the port from which they had sailed. The *founding of Virginia* and *Plymouth* proved but the beginning of British settlement in the new continent, and before the close of the century the whole Atlantic coast from Newfoundland to Spanish Florida was colonised and organised into states. The inevitable conflict between the French and English on the St. Lawrence followed, and was only terminated after eighty years by the *Treaty of Paris in 1763*, since which

date Canada has formed part of the British Empire. Only two years later came the irritation of the colonists at the taxation imposed in the reign of George III., which culminated in the *War of Independence* and the separation of the States from the mother country in 1783. The consolidation of the great Republic and its expansion westward to the Pacific seaboard are familiar history, whilst the friendly rivalry of the two sections of the British people in the continent, divided geographically by a line of latitude, but cemented in a filial relationship to the home country, has led to the prosperous and peaceful development of the tremendous resources of the continent.

World Position and Dimensions.—The vast continent of North America, *third* in order of size among the great land masses, is twice the size of Europe and half the size of Asia. In round numbers, its area is eight million square miles. In form it is often compared with a triangle, with its base in the Arctic Seas, but it is well to correct the idea given on a Mercator's map by reference to the globe. In the Mercator's map considerable *exaggeration of scale* occurs in high latitudes.

The early navigators of the fifteenth century had hugged the shores of the Old World, and gained the Cape of Good Hope and India. They had even ventured as far as the Eastern Archipelago, afterwards called the Indies. The new astronomical idea of the earth as a globe led bold spirits to argue the possibility of a *westward* voyage to India.

Columbus, a Genoese, and therefore within range of the new ideas, ventured west from Palos, his ships being carried by the N.E. trade winds. He gained the Indies, as he thought, tropical islands with coral reefs and volcanic peaks—still named the *West* Indies, to distinguish them from the *Eastern* Archipelago that Columbus set out to seek. The Cabots, as we have seen, venturing out from Bristol, reached the mainland by a parallel N.E.-S.W. track from that more northerly port.

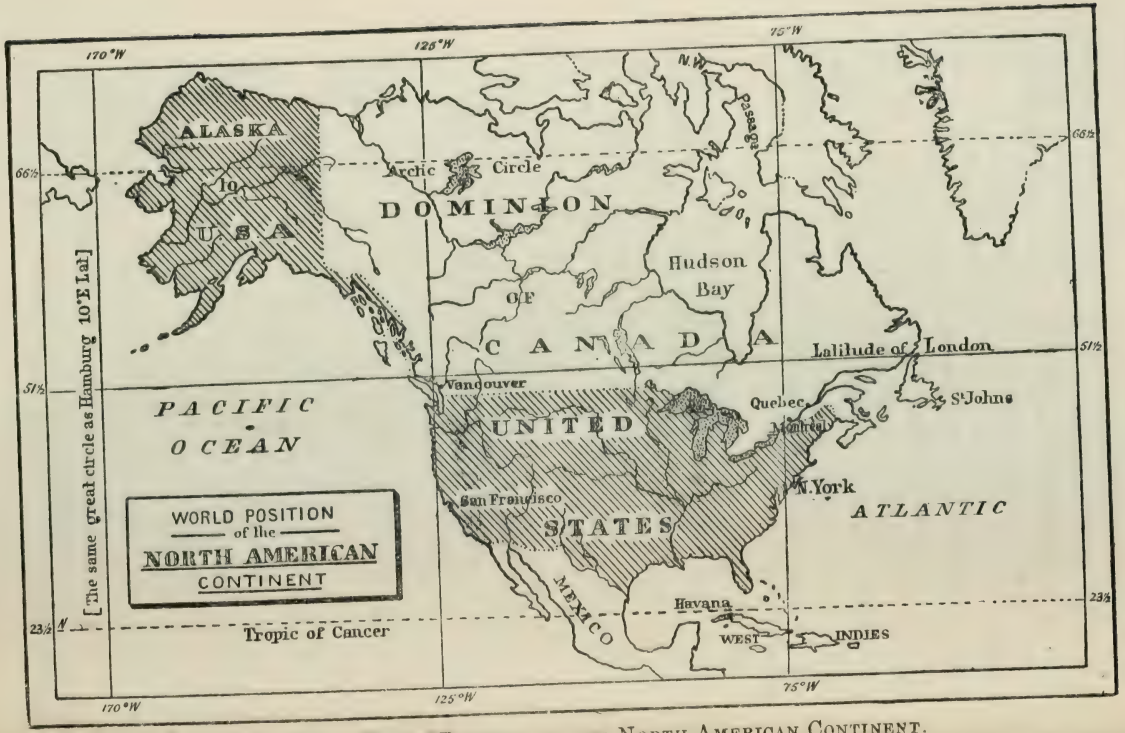


FIG. 244.—WORLD POSITION OF THE NORTH AMERICAN CONTINENT.

The unknown sea was the North Atlantic, now the busiest, most important and best explored of all the oceans. The nearest point of America (St. John's, in Newfoundland) is 1700 miles from the most westerly point of the European Archipelago (west coast of Ireland). So great has been the advance in the four centuries since Columbus that steamers could cover that distance in little over three days.

Columbus approached the Continent from the South, close to the northern tropic line. The Northmen of the tenth century approached it from Greenland, almost at the Arctic Circle. The Continent, therefore, stretches through the whole latitude of the temperate zone $\frac{66\frac{1}{2}-23\frac{1}{2}}{360}$ of $\frac{25000}{1}$ = nearly 3000 miles. Its width from St. John's to Vancouver, along the line of Canadian inter-oceanic traffic is about as long (3075 miles). The *Temperate climate* has favoured its development by the British race.

Separated from Europe by the narrow Atlantic (the "herring-pond" of the Americans), the American continent is divided by the wide expanse of the Pacific from Asia, off whose coasts lies the archipelago of Japan.

The round world is now girdled by a line of train and steamer traffic, roughly parallel to lat. 45° N., which bisects the American continent (*see* Fig. 268). The political boundary of Canada, where not defined by some physical barrier, is set at lat. 49°, some 4° further north.

Canada falls within the *cold* temperate belt; the States within the *warmer* south-temperate zone.

The North-West Passage is more arctic than Spitzbergen; the Gulf of Mexico is 10° nearer the Equator than the Mediterranean.

Montreal and New York are 75° W. of London, with noon five hours (4×75 min.) later. San Francisco and Vancouver are in long. 125° W., whilst Bering Strait, whose submerged platform links the Old World with the New, is on the same great circle as Hamburg.

CHAPTER II.

The General Build of the North American Continent—Relation of Geological to Physical Features.

[Maps to be studied: Geological Map of North America;* Orographical Map; Map of River Systems.]

To the student familiar with the outlines of the geology of the British Isles and Europe, the structure of the North American continent is fairly simple.

Wherever stratified rocks occur, if we bore deep enough, we arrive eventually at the unstratified crystalline series at the base of the Primary rocks. These crystalline rocks appear to be the primeval floor on which successive sediments have been laid down, and from which they have been derived by denudation.

The **crystalline series**, well seen in our Scottish Highlands, in Scandinavia and in Finland, have their representatives on the American continent around the Hudson Bay. If we draw a line from the Arctic Ocean through the chain of lakes—which shows a striking parallelism to the Hudson Bay—as far as the St. Lawrence, we include within the curve the chief area of crystalline rocks in the continent. Over these rocks, not crumpled into axes as in Scandinavia and in Scotland, but gently sloping to the Hudson depression, as Finland does to the Baltic, many rivers converge to the Hudson Bay.

* Outline Map given on page 451.

Only along the St. Lawrence trend do we find a ridge—the Laurentide highlands—sending long streams to Hudson Bay and short streams to the St. Lawrence. Crystalline rocks occur in the central ridges of the two chief upfolds of the American continent, the ancient Alleghany ridges roughly parallel to the Atlantic coast, and the young cordilleran system of the lofty Rockies along the Pacific seaboard. In these cases, denudation subsequent to folding has revealed the *upthrusted* crystalline core. Crystallines and Primary strata are more prominent in the ancient Alleghanies, because denudation has continued through long geological epochs, whereas the Rocky Mountain system is of comparatively recent origin (like the Swiss Alps), and therefore lofty, because

FIG. 245.—GENERALISED DIAGRAM TO ILLUSTRATE THE ARRANGEMENT OF ROCKS IN A MOUNTAIN-UPLIFT.

C—Crystalline core with Granite and Gneiss.
1. Primary; 2. Secondary; 3. Tertiary and Recent sediments.

little denuded. Moreover, the Rockies have not yet attained stable equilibrium. Volcanic disturbances gave rise to many craters, and to lava flows along their flanks, in the early days of their existence; and earthquakes, consequent on settling, are still frequent on the Pacific flank of the chain.

The **Sedimentary rocks** fill the great basin between the Rockies and the above mentioned chain of lakes in Canada, and between the plateau of Colorado and the Alleghanies—*i.e.*, the whole catchment-area of the Mississippi, Missouri and Ohio rivers. They fill the trough of the St. Lawrence, and cover the coastal plain from New York to the low peninsula of Florida.

Primary Rocks.—The *oldest sediments* emerge from beneath later strata along the boundaries of the crystalline

series. They occur especially in the valleys of the Alleghany ranges and the St. Lawrence rift, and recall the Primary rocks of Wales and the English Lake District. Limestones are, however, more prominent. The *Older* Primary rocks predominate in the St. Lawrence Valley. *Younger* Primary rocks—Old Red Sandstone, Coal Measures and New Red Sandstone—are well represented in the Alleghany system and its continuation northward to Newfoundland. Porous rocks of Old Red Sandstone age contain great stores of petroleum; coal measures are extensive and in many places folded as in our South Wales coalfield. Along the eastern edge anthracite has been formed as a result of excessive folding. New Red Sandstone is feebly represented on the eastern flank and in Prince Edward Island.

Large coalfields of the Russian type—nearly horizontal strata, uplifted in gently folded domes—occur in the Mississippi basin as far west as longitude 100° W., but they are comparatively poor in coal.

The Rockies are practically devoid of coal. A few small coalfields occur on the Pacific seaboard of Canada.

Secondary Rocks.—Secondary rocks, here and there overlain by Tertiary sediments, form a broad belt along the eastern flank of the Rocky Mountain system. The salt-bearing strata at the base of the series are well represented on both flanks of the Colorado plateau. Copper slates, resembling those of Germany, occur in rocks of this age among the Alleghany valleys. The Connecticut valley, especially, yields good building stone, of upper New Red Sandstone age, largely used in New York.

American Secondary rocks differ from British facies of the same age in including *coal-bearing strata*. Coalfields of New Red Sandstone age occur in the southern Atlantic states. Others of so late an epoch as that of the English chalk occur in a series along the line of longitude 105° W. between

the Rockies and the Missouri, and cover an area of 50,000 square miles. Secondary Coal Measures are barely represented in the British Isles. Chalk is not so prominent in the American series, though well represented in Texas.

Volcanic rocks, conspicuous by their absence from British Secondary rocks, occur in American Secondary rocks. The volcanic activity may be associated with mountain-upheaval which had preceded it, and the crust adjustments which have accompanied it. The Rockies had still to attain their maximum uplift when the Secondary epoch closed.

Secondary rocks underlie the Tertiary coastal plain of the Gulf of Mexico, Florida and the Atlantic border.

Tertiary Rocks.—The forces which gave the final uplift to the Rocky Cordillera led to the emergence of the continental interior above sea level. Only the present coastal plains were submerged in Tertiary times, and it is on them that we find the clays, loose sands and gravels so characteristic of Tertiary basins. Tertiary seas crept up the basin as far as the present junction of the Ohio with the Mississippi. A series of fresh-water lakes (*Cf.* the Great Lakes of the St. Lawrence system) occupied the surface of the Secondary belt, and left Tertiary patches thereupon. To these we have already alluded. They form the in-fertile "Bad Lands" of the prairie country, the *mauvaises terres* of the early French colonists.

The grand phenomena of the Tertiary period were the immense lava-outpourings which, when consolidated, formed the broad plateaux, now carved into segments by the deep ravines cut (under a rainless climate) by the Columbia, Snake and Colorado rivers, which derive their waters from the culminating snow-clad range beyond the plateaux. These basaltic plateaux, thousands of square miles in area and thousands of feet in thickness, recall the contemporaneous Tertiary basalt flows of Antrim, the Inner Hebrides and Iceland.

Yellowstone Park was the scene of volcanic activity when

the German Eifel and the French Auvergne were being covered with cones and débris. A whole line of lofty volcanic peaks arose along the Pacific flank of the great uplift.

The structure of the Rocky Mountain system is more complex than that of the Pyrenees and Alps in Europe. Folding and faulting have gone on together, giving a complicated series of folded ranges of uplift and crust-blocks. The general arrangement is one of folded ranges along the rims of the

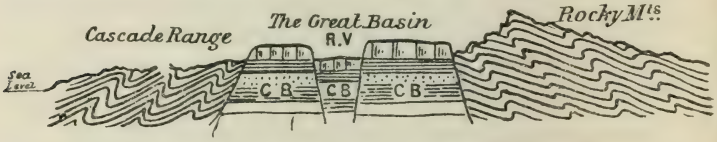


FIG. 246.—SECTION ACROSS THE ROCKIES.

system with crust-blocks in the interior; hence the plateau character of the system.

Summarising, we have :—

(*a*) The crystalline floor of the Hudson basin.

(*b*) The Primary axis of the Alleghanies and the rift-valley of the St. Lawrence.

(*c*) The Secondary strata of the prairie-lands west of the Great Lakes and the Mississippi.

(*d*) The Tertiary and Recent coastal fringes of the Atlantic (from New York to Florida), the Gulf of Mexico and the Pacific coast south of Vancouver.

(*e*) The grand complex of the Rocky Mountain system with crystalline cores, sediments of every geological epoch, structures of every geological type, and volcanic features nowhere surpassed on the globe—an axis which existed from early geological times, but which only culminated in the Tertiary epoch.

Glacial and Alluvial Deposits.—There remains to be considered the modification of the surface and soil by the incoming of the *Ice Age* at the close of the Tertiary epoch.

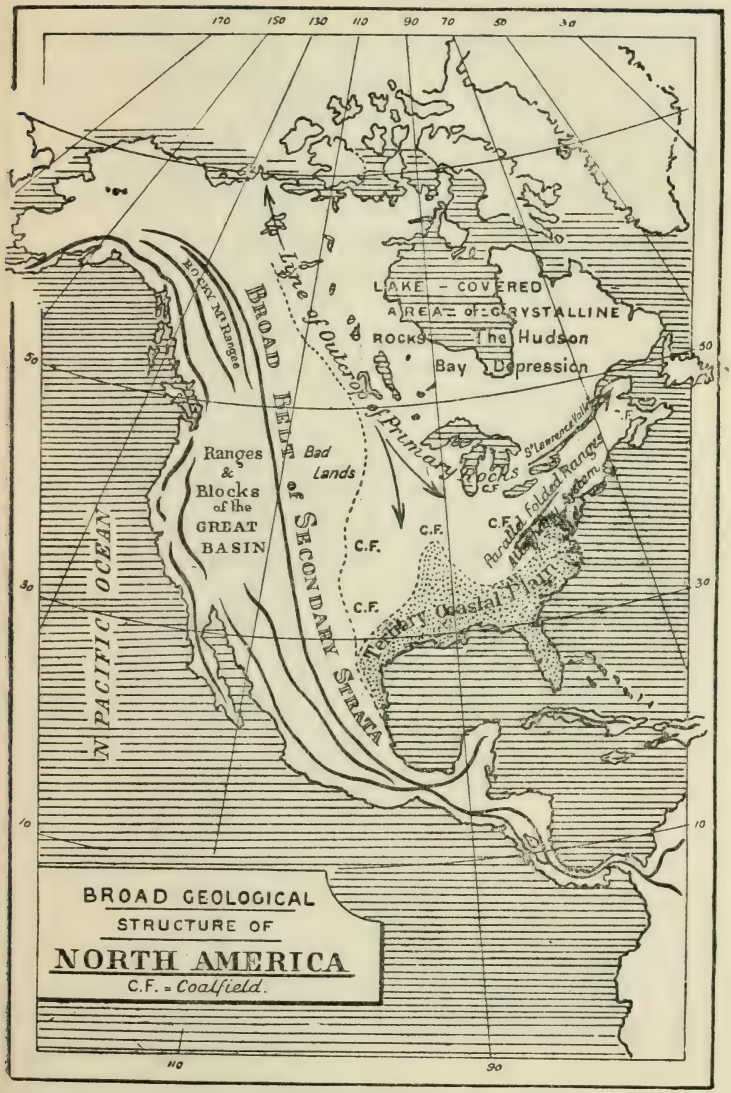


FIG. 247.—BROAD GEOLOGICAL STRUCTURE OF NORTH AMERICA.

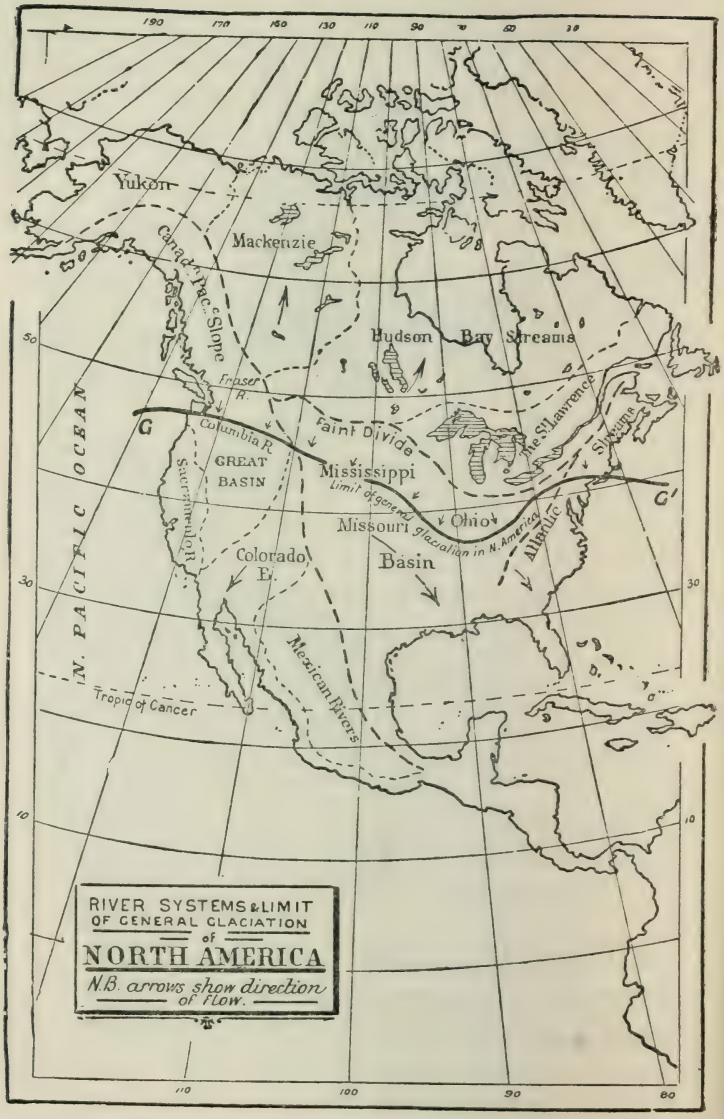


FIG. 248.—RIVER SYSTEMS OF NORTH AMERICA.

Canada, the northern half of the continent, was the region of the great *ice-caps*. Centres of radiation of the ice-flows lay respectively east and west of the region occupied now by the Hudson Bay. Glaciers descended from the Rocky Mountains to the Pacific seaboard. The Hudson Bay ice-flows penetrated as far south as the present drainage lines of the Missouri and Ohio. South of these rivers, and the Frazer and Hudson rivers on the west and east coast respectively, ice sheets only occurred in high parts of the great basin.

Thus the prairie and wheat lands of Canada, the grain states which occupy the angle between the Missouri and Ohio, the Canadian Pacific seaboard, the St. Lawrence valley and the New England states have all been subjected to the rigour of an ice age, and are more or less mantled with glacial deposits, which form the surface soil of the various districts. The student will see that actually the *terminal or frontal moraines* of the ice-cap have determined the course of the two streams—the Missouri and Ohio—and their point of coalescence. Lakes left by the retreat of the ice-cap at the end of the Glacial epoch, and subsequently filled by sediments brought by streams from the melting ice (*Cf.* Switzerland) have given rise to the fertile soils of the grain districts around Winnipeg and St. Paul.

CHAPTER III.

Climatic Conditions on the North American Continent and Their Bearing on Agriculture.

[Maps to be studied: Isothermal and Isobaric Maps; Rainfall Map; Map of Ocean Currents.]

Range in Latitude — Belts of Climate. — The southern extremities of the continent lie close to the *northern tropic*; the northern base of the triangle formed by the continent falls within the *Arctic Circle*. Over a continent of such an extent in latitude climate must vary considerably. On the

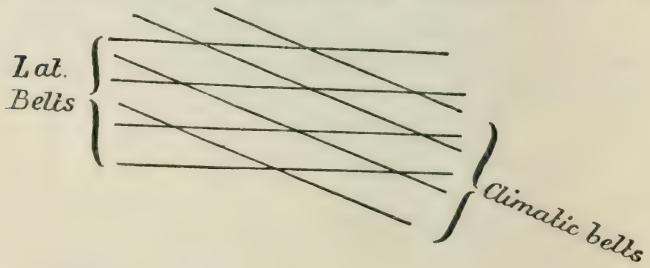


FIG. 249.—RELATION OF LATITUDE TO CLIMATIC BELTS EAST OF THE ROCKIES.

continent of North America the variation of climate is much simpler than on the continent of Europe. Many causes contribute to produce this. The *long barrier* of the Rocky Mountain axis, presented almost normally to the winds and

ocean drifts of the wide Pacific, is the decisive factor in North American climate. East of this wall the belts of climate run parallel to each other in a W.N.W.-E.S.E. direction across the continent, as an isothermal map of mean annual temperatures shows.

West of the Rocky Mountains the strip of continent is so narrow that belts of climate are not so distinctive. The

FIG. 250.—CLIMATIC ZONES.

type of climate along the western seaboard is *insular*, whilst that over the Rockies on the long slope to the Atlantic seas is *continental*, gradually decreasing in severity of extremes as we travel from the leeward-side of the Rockies (the prairie country) to the eastern coast.

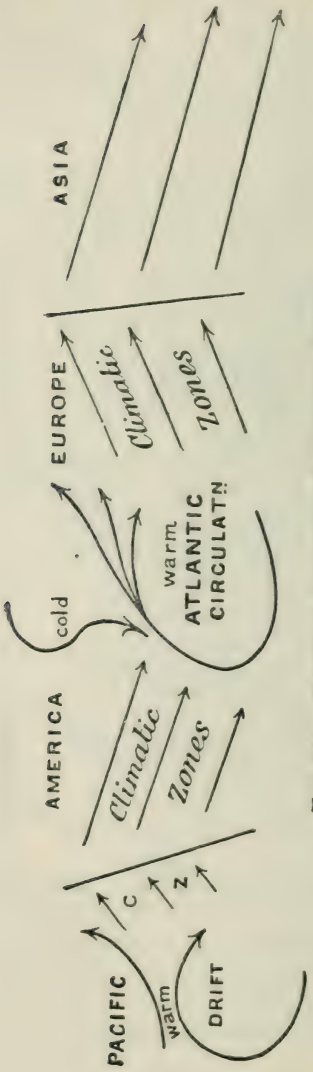


FIG. 251.—GENERAL DIAGRAM OF CLIMATIC BELTS.

Extremes are again more marked in the north than in the south. The great inland sea of the Gulf of Mexico, with its warm oceanic drift, is responsible for the insular type of climate which prevails on the Tertiary coastal plains of the southern states of the Union. The Alleghany ranges are not of sufficient altitude, and are not placed at a sufficiently normal angle to the winds and oceanic circulation of the Atlantic to form a marked climatic barrier.

Fig. 251 illustrates the general arrangement of belts of climate over the Northern Hemisphere, where continent alternates with ocean. It also brings out the fact that the climate of North America must, on the whole, be compared with that of Asia rather than with that of Europe, only British Columbia and California, and similarly placed countries on the west of the Rockies, being comparable with Western Europe.

It will be gathered by a study of the isotherms and

their included temperature belts (*see* Figs. 252 and 253) that places in a given latitude are much colder in January than similarly placed countries in Europe; *e.g.*, Hudson Bay and the Baltic

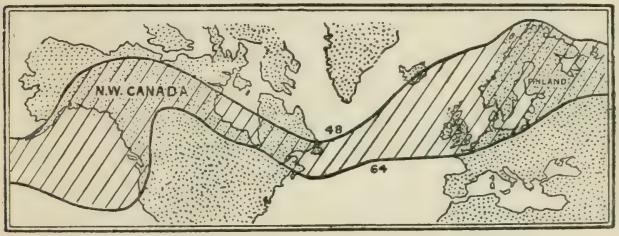


FIG. 252.—JULY TEMPERATURE BELT.

Sea, the Great Lakes and North Italy. On the other hand the *prairie lands* of the interior are considerably hotter in July than any part of Europe in the same latitude. Such facts

FIG. 253.—JANUARY TEMPERATURE BELT.

are evidence of the more continental type of climate which prevails over America.

Winds and Ocean Currents.—The explanation is to be found in the direction of air and water circulation over the Atlantic. The warm south-west winds, which make the climate of Western Europe genial, are part of a circulatory motion which does not favour the continent of America, except along the coast of the southern states.

Cyclones born in low pressure areas over the continent of America have a predominant trend S.E. over that continent, and N.E. over the Atlantic; over the former they travel carry-

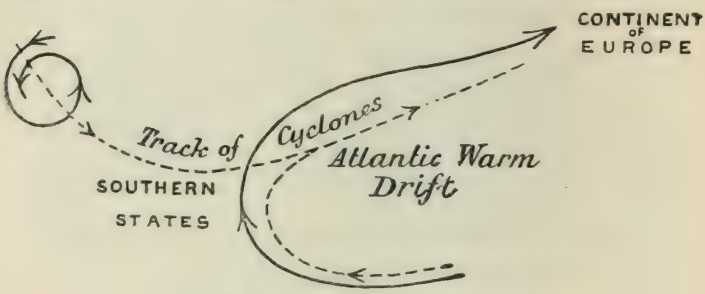


FIG. 254.—STORM TRACKS.

ing colder conditions, while over the ocean they gather heat and distribute it in colder latitudes.

The Pacific seaboard is similarly placed to the Atlantic countries of Europe, though in the wider ocean the warm drift and ocean winds drive in from the west rather than the south-west.

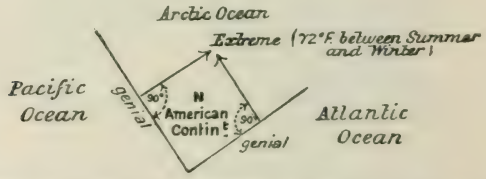


FIG. 255.—RELATION OF GENIAL SEA-BOARDS TO EXTREME INTERIOR.

The Rocky Mountain wall is a most important climatic barrier, owing to its interception of the rain-bearing west winds which blow in from the Pacific. The student has only to compare the map of annual ranges of temperature with that of annual rainfall to discover that the regions of extreme range

are those of low rainfall, whilst those of minimum range are regions of maximum rainfall. The long slope from the Rockies to the Hudson Bay is a typical "rain-shadow" area, comparable in range (60°-70°F.) and climate with the plain of South Russia, and is the most continental in type on the North American continent. Only Siberia—on the larger continent of Eurasia—has a more extreme climate. The rainy slope of the Pacific extending from San Francisco to Sitka, a comparatively small distance away, has but an average range of 20° F.

The outstanding fact of the extreme continental climate of the north is further explained by reference to the great *variation in the length of day* in regions of high latitude. The great North-west of Canada has long, dry days in summer, followed by equally long nights in the winter, *i.e.*, extremes of duration of sunshine—the maximum period affording great heat, the mid-winter minimum resulting in extreme cold. In the southern states not only rainfall, but a roughly *equal distribution* of sunshine throughout the year, serve to explain the equable or insular nature and low range of the climate.

Two regions of North American climate remain to be noted. The first of these is the practically *rainless region* of the Great Basin, enclosed between the Cascade Range and the Rockies of the western states, which, in July, is one of the three *hottest regions of the world*, considerably hotter than the equator itself. The sun is directly over the Tropic of Cancer on Midsummer Day, but the land mass—so susceptible to heat, and in this particular area untempered by rainfall—draws the area of extremes still further north until the region of greatest heat falls almost entirely *outside the tropics*.

The second of these two regions, the coastlands of the North-West Passage—so long the allurement and the despair of explorers, but in 1906, for the first time, navigated with success—lies in the area of extremest winter cold on the Continent. The region is a bay of polar climate projecting

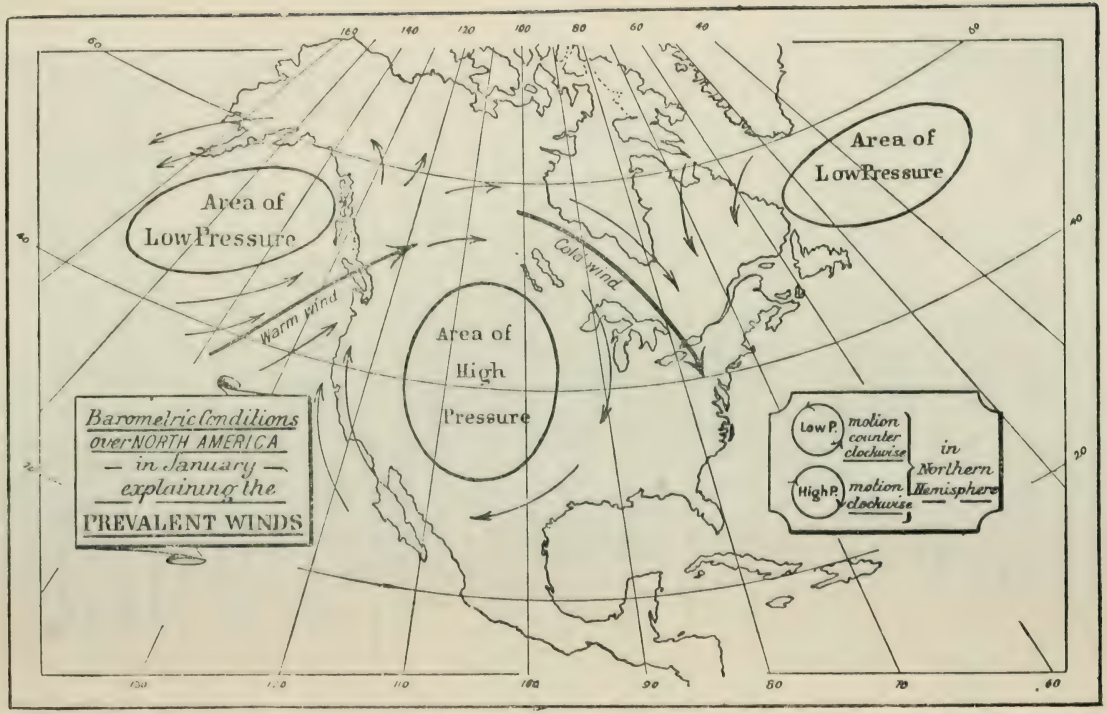

Area of Low Pressure
Area of Low Pressure
Area of High Pressure
Warm wind
Cold wind
Barometric Conditions over NORTH AMERICA — in January — explaining the PREVALENT WINDS
Low P. motion counter clockwise
High P. motion clockwise
in Northern Hemisphere

FIG. 256.— BAROMETRIC CONDITIONS OVER NORTH AMERICA IN JANUARY EXPLAINING THE PREVALENT WINDS.

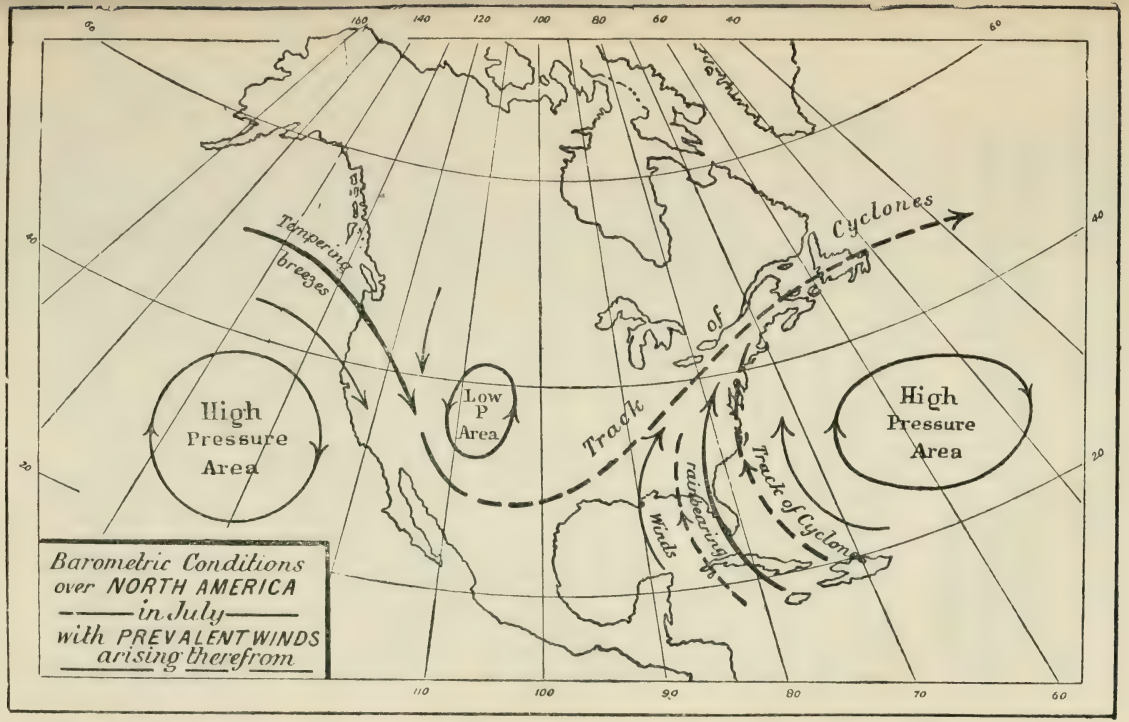


FIG. 257.—BAROMETRIC CONDITIONS OVER NORTH AMERICA IN JULY, WITH PREVALENT WINDS ARISING THEREFROM.

southward over Canadian territory, even beyond the Arctic Circle, and colder than Spitzbergen, which lies 10° nearer the Pole.

A map of isobars (lines of equal barometric pressure), further serves to explain the interesting features of North American climate.

Prevalent Winds.—The *January* diagram explains the extreme cold of Lower Canada and the eastern states, arising from winds blowing from the north-west, as well as the genial winters of California, influenced by inflowing warm winds from tropical Pacific waters. (Fig. 256).

The *July* diagram shows the tempering influence of cool sea breezes from the north-west on the western states, and the rainy conditions of summer climate in the Southern States. The average track of cyclones is inserted for comparison. (Fig. 257).

[*See* Section I., *Physical Geography*, for Explanation of the Laws which Govern Climate.]

Vegetation, Forestry and Agriculture.—The student will readily understand that climate and soil determine the natural vegetation of a continent as the coloniser first meets it. The soil is perhaps a less important factor than either temperature or rainfall. A considerable supply of rainfall, accompanied by the lesser effects of insolation and frost, will secure the degradation of the hardest surface into fairly fertile soil. It is the rainless region that is barren in soil. Temperature determines the character of the vegetation, whether Tropic or Arctic, or of an intermediate type. Original vegetation and subsequent agriculture are largely determined by the climatic provinces into which a continent is naturally divided.

Climatic Units.—

In Canada it is easy to distinguish five such climatic and productive units.

(1) The Valley of the St. Lawrence,
(2) The Grain-lands of the Interior,
(3) The Pacific Border,
} followed by the Canadian Pacific Railway.

(4) The Hudson Bay Depression,

(5) The dreary Tundras of the Arctic Coastlands and Archipelago.

The States, lying further south, offer contrasts whilst affording points of comparison. They may be divided as follows:—

(1) The New England States,
(2) The Mississippi Basin, east and west,
(3) The Pacific States,
} *Cf.* (1) (2) (3) above.

(4) The coastal plain of the Gulf of Mexico (a depression),

(5) The barren "Great Basin" on the Rocky Mountain uplands.

Numbers (4) and (5), respectively a basin and a desert in both countries, afford the *widest contrasts* of temperatures and of productions to be found on the Continent.

(1) *Valley of the St. Lawrence and the New England States.*—The valleys of *Lower Canada* and the *New England* states have a climate corresponding closely with that of the *Baltic* depression in Europe—warm and dry in the summer and sufficiently cold in the winter to block the mouth of the St. Lawrence with ice. Forests like those of Sweden and Finland, growing on a similar geological formation, give rise to the lumbering industries of the St. Lawrence valley. Dairy farming thrives amid the parallel ranges between the St. Lawrence and Nova Scotia. Fruits of English and French character ripen in the warmer latitudes of Toronto and Buffalo in the region of Lakes Ontario and Erie, and the valley of the Hudson.

(2) *Canadian Grain-lands and the Mississippi Basin.*—The forests give way to *grass-lands* as we move to the drier *interior*, especially beyond the Great Lakes and the Mississippi. Whilst the low rainfall is unfavourable to the growth of forests, the warm, dry summers are especially suitable for the ripening of grain; wheat, rye and maize are grown in immense quantities on the alluvial and morainic soils of the interior: rye extends further north than wheat, maize further south. The whole nature of the climate and productions recalls the great open *Plain of Russia*. Even Siberia, with its long, warm, dry summer days, is emulating Manitoba in the development of wheat farms. The poorer grass-lands are given up to ranches—farms for the rearing of live stock.

(3) *The Canadian Pacific Border and the Pacific States.*—The *Pacific border* is unlike the rest of the continent in both climate and productions. It is comparable in Canadian territory with the *British Isles*, and in the Californian region with the *Mediterranean*.

The mountain-slopes support magnificent forests as far north as latitude 60° N., and afford much lumbering. The fertile garden of California is one vast orchard, yielding fruits of French and Mediterranean types.

(4) *The Hudson Bay Depression and the Coast of the Gulf of Mexico.*—The *two great depressions* of the American Continent, the *Hudson Bay* and the *Mexican Gulf* regions, afford remarkable contrasts.

Geologically, they are as wide apart as can be; crystalline rocks belonging to the *oldest* epoch form the basin of the Hudson Bay, while the coastlands of the Gulf of Mexico and Florida, with their extension along the Atlantic border as far as Cape Hatteras, represent the *newest* lands on the American Continent. Climate is equally widely contrasted. Arctic conditions of the severest type seal the mouth of the Hudson Bay for months in the year with ice. Only the *James Bay* region can be compared with the *White Sea* of Northern

Russia, and it lies in the latitude of England; and here mosses and lichens give way to pine trees. The *Gulf of Mexico*, on the other hand, just outside the Tropics, has a *tropical* climate, owing to the cauldron-like circulation of warm currents from the Equatorial belt—currents which issue at the Straits of Florida in the remarkable *Gulf Stream*. Rice, cotton and sugar thrive in the hot, damp climate of these coastal plains. The slopes of the limestone hills of Tennessee and Kentucky ("the blue-grass States"), north of these plains, as well as those of Virginia, overlooking the Atlantic slope, yield much tobacco.

(5) *Arctic Coastlands and the Rocky Mountain Uplands.*—The *frost-bound* tundras of the Arctic shores of Canada present an extreme contrast to the *burned-up* basin on the elevated plateau between the Rocky Mountains and the Sierra Nevada, the hottest region on the American Continent—50° F. hotter in summer and 80° F. hotter in winter than Arctic Canada. Nowhere in the world can a more marked change in climate and fertility be found than on the two sides of the Sierra Nevada range, in lat. 35° N. The "big trees" of Mariposa and Yosemite grow on the rainy slope, above the gardens of California. Prickly cacti and scrub prevail on the dry plateau of the Great Basin.

CHAPTER IV.

Mineral Resources, Industries and Population Centres.

[Maps to be studied: Geological Map; Industrial Maps; Railway Maps.]

AGRICULTURE tends to *distribute* the people over the land: manufacturing industries lead to an *aggregation* of the population in groups of towns around a central metropolis. In the former case it is not only fertility but also the *stage of development* reached which determines the density of population over a given area.

Fertile tracts long settled, as in the St. Lawrence Basin and New England States, support more people than the equally fertile but only recently-developed prairie lands of the west. With the increase of facilities for transport and export, the thinly-peopled virgin-lands of the west may be expected to support a much larger population.

Coalfields and *traffic-lines* form the areas and loci of dense populations, and these factors combine to make the earliest settled and fertile states of New England and the Laurentian provinces of Canada the busiest areas on the North American continent.

Mining centres, apart from coalfields, are but sparsely populated; the ore is sent to the coal regions to be smelted, and so a railway to the nearest coalfield or the handiest point of export becomes a necessity.

Older Primary Rocks.—*Iron* ores are usually associated with the coal deposits of the younger Primary rocks. *Lead* ores are common in the ancient limestone, which in many countries (including the above thickly-populated areas) forms the basin in which the Coal Measures are laid down.

Gold, *Platinum*, *Silver-lead* ores, *Copper*, and especially the native metals (gold, silver and copper) more often occur along *lines of fracture* of the earth's crust, and therefore on the flanks of mountain uplifts and the *rims* of block mountain-plateaux. This is very strikingly illustrated in Europe in Germany, Bohemia, Spain and the Urals.

Copper and *Nickel* are associated in the quartz veins of the crystalline rocks along the northern edge of the Great Lakes, *i.e.*, along the line of the Canadian Pacific Railway. The nickel remains to be worked, the copper has been considerably exploited, while recently rich *gold* supplies have been detected in the same region.

Graphite occurs in considerable quantity. *Iron*, of the magnetite (Fe_3O_4) variety (seldom found in coalfields), is mined in these ancient crystalline rocks, both on the Canadian and New England sides of the St. Lawrence. The valuable mineral *Apatite* occurs in masses.

The older Primary rocks of Michigan and the St. Lawrence trough yield good *building stones*, *slates* and, in the folded ranges between the trough and the coast, *marbles*—derived from the metamorphism of ancient limestones. Many of the porous sandstones and dolomitic limestones afford storage for *natural-gas* and *rock-oil*.

Younger Primary Rocks.—The great mineral wealth of the Continent in *oil*, *iron* and *coal* is, however, chiefly associated with the younger Primary rocks. The porous sandstones of Old Red Sandstone age which encircle Lake Erie and crop out from beneath the huge coalfield of Pennsylvania, form the chief storehouse of *petroleum*. The oil is the product

of destructive distillation of organic matter—effected by heat and pressure in the process of mountain making—lying below the porous sandstones, into which the natural gas and oil have distilled. The limestone which occurs sandwiched between these oil-bearing strata and the coal seams, has *leadores*, like its English equivalent.

The *Coal Measures* cover an enormous area in the basin of the Ohio, and flank the Alleghany ranges on the interior slope from Pennsylvania to Alabama. They have their widest extension in the former state. In the west the seams lie *horizontally*, but in the east they have been involved in the process of mountain making—that of the final uplift of the Appalachian axes—and as a consequence have been *folded*, crumpled and converted largely to *anthracite*.

Cannel coal, the "parrot" coal of Scotch miners, occurs on the western edge, in the Ohio Valley, and is, as its name (=candle) implies, excellent for gas-making.

Bituminous coal, the best for household purposes, is mined on the plateau; *anthracite* in the eastern valleys. True coal-basins of considerable extent occur in Michigan, between the lake of the same name and that of Huron; in the angle between the Mississippi and the Ohio; and again, across the great river, S.E. of St. Louis.

Secondary Rocks.—*Coal* is not confined to rocks of what we call the Carboniferous age. Soft coals, covering tens of thousands of square miles in area, occur in the belt of Secondary rocks which flanks the eastern rim of the Rocky Mountains. They belong to the age of our English chalk, but point to very different conditions of deposit. Belonging to a much later epoch than the Carboniferous, and having been subjected to comparatively little pressure from overlying strata, they are not so compacted, and are much richer in volatile compounds than ordinary coal. It is interesting to note that at Brora, in Sutherland, North Britain, there is a small deposit of similar

character and age. The coalfield of Richmond, Virginia, is of New Red Sandstone age.

Salt, which in England is usually associated with the New Red Sandstone, is not confined to these rocks, but occurs also in both older and younger rocks in America. This New Red Sandstone is one of the principal building stones in the great cities of New England.

Gold is scarce in the ancient Appalachian axis. In the Rockies, on the other hand, it was the chief incentive to mining industry. It occurs disseminated in small flakes in the quartz veins and "auriferous slates" (Secondary rocks) of the Pacific flank. But it was first discovered in the *alluvial deposits* ("placers") of the rivers of the Pacific seaboard, and from them it was first obtained by various methods of separation, made easy by the high specific gravity (19·3) of gold as compared with quartz (2·5). Now the metal has been traced back to its source, and the degradation of the gold-bearing rocks—the result of ages of denudation in the ordinary processes of nature—is rapidly effected by crushing-machines (*i.e.*, stamps).

California has exported gold for half a century. The valleys leading down to Vancouver were next explored; new deposits are being opened out further north, and will lead to the development of Fort Simpson: the immense field of Klondyke, close to the Arctic Circle, is now being worked with great success.

Silver and *Lead* occur in the same fractured mountain rims, the western range being again more productive than the eastern. The United States mines rank *first* in the world for the output of silver.

Tertiary and Recent Rocks.—The coastal plains and the lake deposits of the interior offer little in the way of mineral wealth. *Diatomaceous earth*, used in the manufacture of metal-polish, and non-crystalline *phosphates* (similar to those

occurring in East Anglia), useful as manures, are found along the southern Atlantic states.

Industries and the Distribution of Population.—We are now in a position to understand the distribution of population over the continent.

The *Tundras belt* within the Arctic Circle and the Hudson Bay depression, as well as the *arid plateau* of the Colorado basin, are the areas of scantiest population. The *great forests* support a sparse population, chiefly gathered at the saw-mills and paper-factories at the outlets of the valleys. The wide *prairies* are scarcely more densely peopled; towns spring up at centres suitable for flour-milling and conveniently placed for export. Winnipeg is the best example in Canada. Chicago, far outstripping Winnipeg, is the American focus.

The *fertile valley* of the St. Lawrence, brought to a high pitch of cultivation, and the *genial fruitful lands* of the Pacific seaboard support a dense population for agricultural areas.

Similarly, the *rich, damp, hot, coastal plains* of the southern states—yielding crops of rice, sugar, cotton and tobacco—find employment for large numbers of negroes, descendants of the slaves of a former century. Galveston, New Orleans and Mobile on the Gulf of Mexico, Savannah and Charleston on the Atlantic, busied in the export trade, and more recently in manufacture also, are the foci of population in these states.

The agricultural produce of the great interior finds its way to the *river-ports* on the Mississippi and its tributaries. *Milling* and *packing* lead to the aggregation of people at these points of export and exchange: St. Paul, St. Louis, Cincinnati, Cairo and Memphis are such centres.

In the same way, the *highway of the St. Lawrence*, so thoroughly canalised, and the Great Lakes, carrying navigation to the heart of the interior, only 400 miles from the wheat-lands of Manitoba, have led to clusters of towns at the

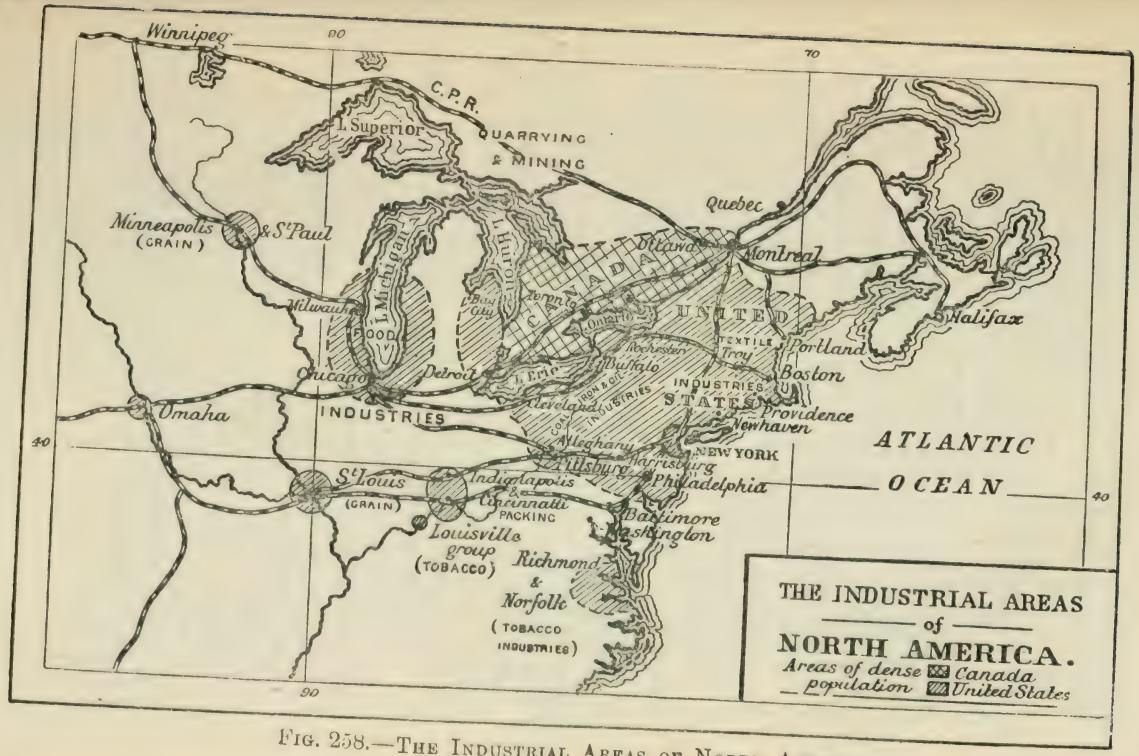


FIG. 258.—THE INDUSTRIAL AREAS OF NORTH AMERICA.

crossing-points and other suitable sites. Chicago and Detroit, Toronto and Montreal are centres of population.

The untold *mineral wealth* around the Great Lakes, in the Ohio Basin, and on the flanks of the Alleghanies, accounts for the fact that the *most densely populated region* on the continent lies between the Laurentian lakes and river on the west and the Atlantic seaboard on the east.

Cleveland and Buffalo, on the "States side" of the water frontier which divides them from the Dominion; Pittsburg, in the midst of the *oil-wells*, *iron-mines* and *coal-fields* of the Ohio Basin; Boston, New York, Philadelphia, Baltimore and Richmond, *on the open Atlantic, facing Europe*, are all foci of dense populations.

The States of New England—most English in character among all the States of the Union—contain the principal seats of the *textile* industries. Cotton and woollen goods are woven. *Watch-making* is an important industry. Across the Alleghanies, the *iron and steel industries* flourish in the Pittsburg group of towns. *Oil-export* engages thousands in the Ohio Valley, both upper and lower. Cleveland is a busy centre of export on the Lake-highway. Buffalo and Rochester share in the industries of the Ohio Valley.

Cincinnati and Chicago, the latter the city of most prodigious development in a country of rapid strides, are centres of the *grain and meat industries.*

Detroit is the focus of industry in Michigan. It has special importance in copper.

Ontario's life converges on Toronto. Montreal is the emporium of Lower Canada.

Denver, where railways converge before climbing the Rockies, is a subsidiary population centre. Mining industries in the neighbouring mountains account for the aggregation of people.

The "Gates of the West," Vancouver (British Columbia) and San Francisco (California), are the foci of commerce along the Pacific seaboard.

Vancouver has excellent *coal*; the harbour of Esquimault forms a fine meeting-place for ocean-going vessels and Trans-Canadian trains.

San Francisco is the natural outlet of the *fruit-farms* of the Sacramento Basin. The terminus of the principal lines of railway across the States, from ocean to ocean, with the finest harbour on the coast, it has inevitably become the focus of shipping, export and import, between the States and Australia, Japan, China and the Philippines.

The *salmon-fishing* ground of the fiord-like Puget Sound, just south of the lat. 49° N. frontier, has attracted population to the neighbourhood of Seattle. *Lumbering* and *mining* swell the numbers.

The *seal-fisheries* of the Canadian-Pacific seaboard, the *cod-fisheries* of the great "banks" of the St. Lawrence Gulf and the continental shelf around Newfoundland, deserve mention.

CHAPTER V.

Traffic Lines on the North American Continent. Ports and Communication with the Outer World.

[Maps to be studied: Commercial Maps of Canada and the United States; Map of the World; Map of the North Atlantic.]

THE *river-highways* of the St. Lawrence and the Mississippi formed the natural *lines of entry* of settlers into the American continent.

The valley of the Hudson and the zig-zag valleys of the Alleghany ranges offered access to the interior for New England settlers. The *rich resources* of the Ohio valley made it a line of advance.

The great inland chain of fresh-water lakes, seas in dimensions, carried the St. Lawrence highway into the heart of the continent where all three lines of access converge.

The *Mississippi*, *Ohio* and *St. Lawrence* rivers, therefore, were the natural determining factors of development, and their valleys retain their original importance as traffic lines, because of their fertility and resources.

The discovery of *gold* in the distant Rockies, the agricultural possibilities of the *prairie-lands*, and later, the development of *fruit-farms* on the Pacific coastlands, as well as the possibilities of traffic with newly-developing lands across the Pacific, led to the gradual extension westward of the main lines of trade and intercourse.

Then followed the opening of *lateral* lines, in Canada to the North and in the United States to the fertile coastal plains of the Mexican Gulf and the Atlantic southern states.

Railways.—In Canada, lateral extensions of the Canadian Pacific trunk-system are few; the frozen north offers few temptations to advance. Sooner or later, the ports of the Hudson Bay must link up with Winnipeg. The gradual advance northward on the prairie-lands of the "*rain-shadow*" *region* is leading to branches which reach the *navigable* Saskatchewan river. One of these forking, rather than branching, from the main line of the Canadian Pacific Railway at Winnipeg, crosses the prairies in a somewhat higher latitude, and is destined to be carried through the new mining regions

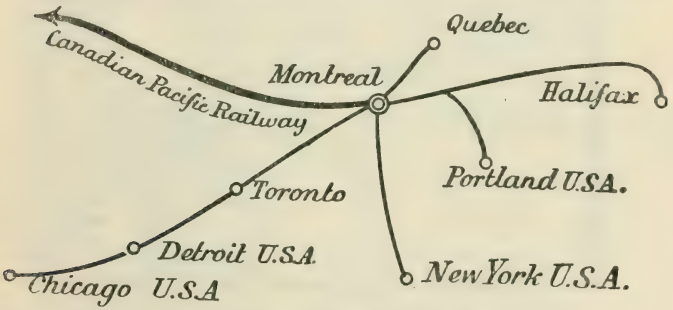


FIG. 259.—TRAFFIC LINES AROUND MONTREAL.

of America just north of the older Cariboo gold-mines, to terminate eventually at Fort Simpson, whose harbour opens out by the Dixon Entrance to the Pacific, and is within easy access of the *coal* on Queen Charlotte Island.

In the United States, railways have been enormously developed, until, east of the Mississippi, the country is covered with a complex system of lines. West of the Mississippi, the trunk lines strike along tributary *valleys* and over *passes* on the Rocky cordillera to the Pacific termini.

Canadian Railways.—The *foci of trade*, and therefore the centres of communication in Canada, are Montreal, Winnipeg and Vancouver. Connecting these three centres is the trans-continental system of the Canadian Pacific Railway. From Montreal, trunk lines radiate along every valley. The C.P.R. follows the Ottawa Valley and the northern side of the Great Lakes.

The principal railway of the St. Lawrence Valley, the Grand Trunk Line, links Chicago and Detroit, great cities of the Union, with the Canadian lake and river foci of Toronto,

Fig. 260.—Traffic Lines Around Winnipeg.

Montreal and Quebec, hugging the northern bank all the way. The Grand Trunk Pacific Route to Prince Rupert on the Pacific is in course of completion.

The Hudson *Valley* and the Champlain *depression* afford easy railway communication with New York, thus bringing the greatest emporium of each of the countries into touch.

The *International Railway* continues the trend of the C.P.R. as far as the Atlantic seaboard.

Winnipeg is the *mid-country focus* of traffic and industry in Canada. The trunk line follows the trend of the early

settlers, and therefore the line of most cultivation and population. A new line strikes N.W. to the newer farms of the Saskatchewan basin. Both lines have connection with Lake Winnipeg, and before long the Nelson river valley may be expected to afford a new outlet for the grain, fur and timber exports of the interior. Fort York is considerably nearer Liverpool than either Montreal or New York. To appreciate this, the student must *refer to a globe*, and so correct the erroneous impression conveyed by a Mercator's map. Ice hampers the Bay, however, to as great an extent as it does the White Sea of Russia and its port of Archangel. Climatic conditions are more extreme than in the Baltic.

The Canadian Pacific Railway takes advantage of *two passes* to gain access to *gold-bearing valleys*—the more

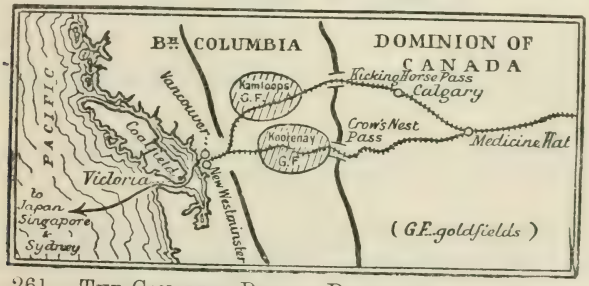


FIG. 261.—THE CANADIAN PACIFIC RAILWAY IN THE ROCKIES.

northerly *Kamloops* and the more southerly *Kootenay*—and then converges on Vancouver.

The extension of the new line to Prince Rupert will tap the gold districts of *Cariboo* and *Omenica*. North of Prince Rupert and the Dixon Sound, the fiord-like coast with its "Skerry-Fence" is in possession of the United States.

Trunk Lines of the United States.—The United States, with twelve times the population of the Canadian Dominion, require proportionately more railways, and the country between the Mississippi water-highway and the Atlantic, and

between the Great Lakes and the Gulf of Mexico is covered with a maze of railway systems.

From these it is possible to extricate the main E.-W. *trunk-lines* running from *New York* on the east to *San Francisco* on the west.

The most northerly of these systems links *New York*, via the mining and smelting centre of *Pittsburg*, with *Chicago*, the focus of Michigan population and industry. It crosses the wheat and maize farms of *Minnesota* around *St. Paul*, and then, before crossing the silver and lead mining district of *Butte* in the Rockies, traverses the *Yellowstone Park* volcanic

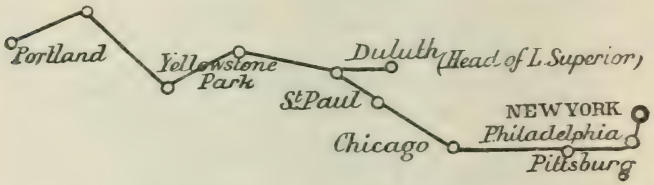


FIG. 262.—TRUNK LINE OF THE NORTHERN PACIFIC RAILWAY (U.S.A.).

basin along the line of the river. It descends from the magnificent *Snake River* basaltic plateau to the seaboard of *Portland* by way of the *Columbia river*. (Fig. 262).

A mid-country system runs very directly across the continent to terminate in San Francisco. From the railway centre of *Pittsburg* a northerly route calls at *Chicago* and then at *Omaha*, a coal and railway centre. It then climbs by way of the *Platte Valley*, north of Denver, and crosses the dreary plateau around *Salt Lake City*, prior to descending the magnificent valley of *Yosemite*, which opens out to the gap of *San Francisco*. A southern loop includes St. Louis. (Fig. 263).

The third great system of trunk lines serves to link up the great ports of the United States. It follows the Tertiary coastlands, traversing the rice, cotton and tobacco-growing southern

states and calling at *Richmond* (the tobacco port), *Savannah*, *New Orleans* and *Galveston* (cotton ports). It then takes advantage of the Rio Grande valley, keeping north of the frontier, and reaches the Pacific at *Los Angeles*. (Fig. 264).

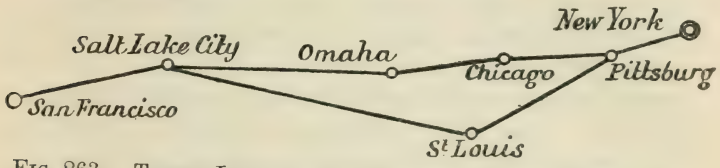


FIG. 263.—TRUNK LINES OF THE CENTRAL PACIFIC RAILROAD.

A trunk line follows the fertile trough of California, parallel to the coast, to *Portland* and *Vancouver*.

An inner line traverses the tobacco belt, and calls at the

FIG. 264.—THE TRUNK LINES WHICH FOLLOW THE COASTLANDS.

newly-developed iron centre of *Alabama*, on its way to *Dallas*, the agricultural focus of Texas.

River Communication in the United States.—The *continental interior* is well suited to the development of great rivers; low angle of slope over a broad basin favours deep and ramifying streams, so that no district is far from a navigable river.

The rivers from the Rockies are loaded with sediment derived from the soft Secondary and Tertiary strata on their flanks. The result is that, below Cairo, the Mississippi, where its current is slow, is filling up its bed by deposition, and so raising it above the surrounding country. This is necessitating *dykes*, to protect the low-lying lands on either side. Slow rate of flow, together with enormous and constant volume of water, have made the Mississippi one of the world's chief river-highways. Many of its tributaries are nearly as important as the main stream; the Ohio should be mentioned particularly.

Specially-built river-steamers can reach the Tennessee tobacco plantations. The Ohio is navigable to *Pittsburg*. *St. Paul* can be reached on the Mississippi. The Missouri is navigable almost to its source.

Even the rivers of the coastal plain give navigable access to the foot of the mountains.

The Water-ways of Canada.—The St. Lawrence is the great water-way of Canada. Filtered by lakes, it requires no dykes. On the other hand, it is at a disadvantage in opening into a gulf which *freezes for twelve or thirteen weeks* in the year. Rapids between one lake and another in the chain, and especially the *Niagara Falls*, further hamper its usefulness. Canalisation has largely overcome these difficulties.

The *Welland Canal* avoids the Niagara Falls and Rapids.

The *Rideau Canal*, using the river and lake of the same name, links the Ottawa with Kingston, on Lake Ontario.

The *Sault St. Marie* rapids are overcome by a pair of canals—the "*Soo*" *Canals*—one on either side of the channel, which is also the frontier. It is said that the yearly tonnage of ships using these canals exceeds that of the ships using the Suez Canal. The Great Lakes offer navigation on the scale of an inland sea; one may sail on Lake Superior for two or three days without seeing land, and may encounter storms equal to those met with at sea.

Duluth is the head of navigation, and belongs to the United States.

Port Arthur is the terminus of Canadian traffic, and is conveniently served by the C.P.R.

Chicago is the chief port on Lake Michigan. *Detroit* is a busy mining centre and port on the small lake St. Clair. Both are on the United States side of the frontier.

The States possess *Cleveland* and *Buffalo*, oil, coal and iron exporting towns on Lake Erie.

Canada has *Toronto* and *Kingston*, foci of industry for the province of Ontario, on the lake of that name.

Montreal is the great emporium and sea-port. *Quebec*, further down the estuary, is but one-fourth the size.

When ice closes the river, the open ports of *Halifax* (Canada) and *Portland* (U.S.A.), joined to Montreal by rail, are used as winter outlets.

St. Louis and *Memphis* are the chief river ports on the Mississippi; *Louisville* stands on the Ohio tributary. These ports gather up the wheat, hay, maize and meat exports of the great Mississippi basin, and the tobacco of the Kentucky limestone lands.

New Orleans, on the digitate delta, is the gate of the basin and the chief port on the Gulf of Mexico, gathering up all its different products.

Galveston ships cotton and the live stock of Dallas.

Mobile is the outlet of the Alabama iron district and shares in cotton export.

The Atlantic Ports of the States.—The ports on the Atlantic seaboard of the United States are conveniently divisible into two groups:—

(1) Ports of the New England States—Portland, Boston, New York, Philadelphia, Baltimore.

(2) Ports of the Southern States—Richmond, Charleston, Savannah.

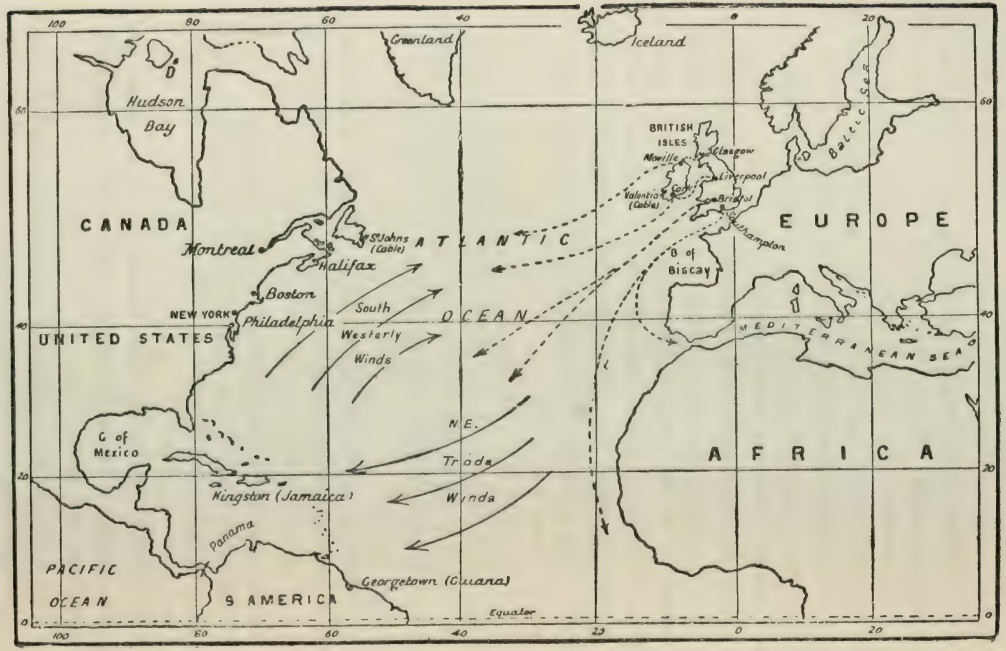


FIG. 265.— MAP OF BRITISH PORTS FACING THE ATLANTIC.*

* *Students should insert additional names.*

(1) The Ports of the New England States.—*Portland* owes its importance very largely to the fact that it is the nearest ice-free port to the St. Lawrence valley.

Boston, the oldest port, founded by the Pilgrim Fathers (1620), is an important calling-place for many trans-Atlantic vessels. It is the gate of the busy industrial state of Massachussetts.

New York owes its origin to the Dutch Settlement of New Amsterdam (1664). It is second only to London among the

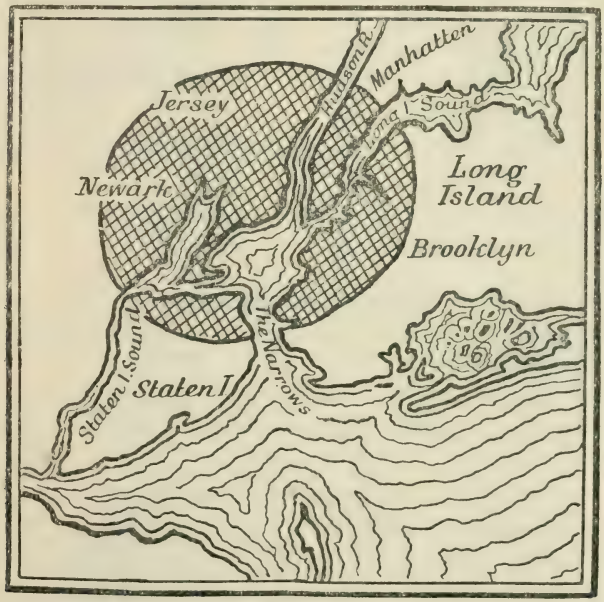


Fig. 266.—Site of New York.

cities of the world. The metropolis extends along the banks of the three channels which meet—the Hudson River, Long Island Sound and the Narrows. The focus of American life, it is engaged in general export and import.

Philadelphia ranks next in importance to New York. It stands at the head of the Delaware estuary, conveniently placed to serve as the outlet of the anthracite, oil and steel of the Pittsburg area. It has grown to twice the size of Liverpool.

Baltimore, standing at the upper end of the long fiord-like Chesapeake Bay, into which the Potomac flows, is another port within easy access of Pittsburg.

(2) THE PORTS OF THE SOUTHERN STATES.—South of Chesapeake Bay begin the tobacco plantations and agricultural lands of the southern states.

Virginia exports its tobacco, both in leaf and manufactured, from *Richmond* and *Norfolk*.

The chief outlets of North and South Carolina are *Wilmington* and *Charleston*.

Savannah, whose river forms a state-boundary, is the chief cotton-outlet on the Atlantic.

Pacific Outlets.—Canada and the States.—On the Pacific, Canada has the harbours which group around *Vancouver* at the terminus of the C.P.R.

The States have *Portland* and *Seattle* in the north, *San Francisco* in a middle position, and *Los Angeles* near the southern frontier.

Vancouver owes its prosperity to several factors. The gold-bearing valleys converge on it. The trunk line of Canada ends there. A fertile and fruitful coastal strip runs to the north, and excellent coal occurs in the off-lying islands. It is Canada's gate to the Pacific. The S.E. corner of Vancouver Island is occupied by the harbours of Esquimault and Victoria.

Puget Sound, on which *Seattle* stands, opens out into the same channel. Trade here is similar to that of Vancouver; the export of timber, canned-salmon and metal-ore engages the inhabitants. *Portland* is the outlet for Columbia river salmon.

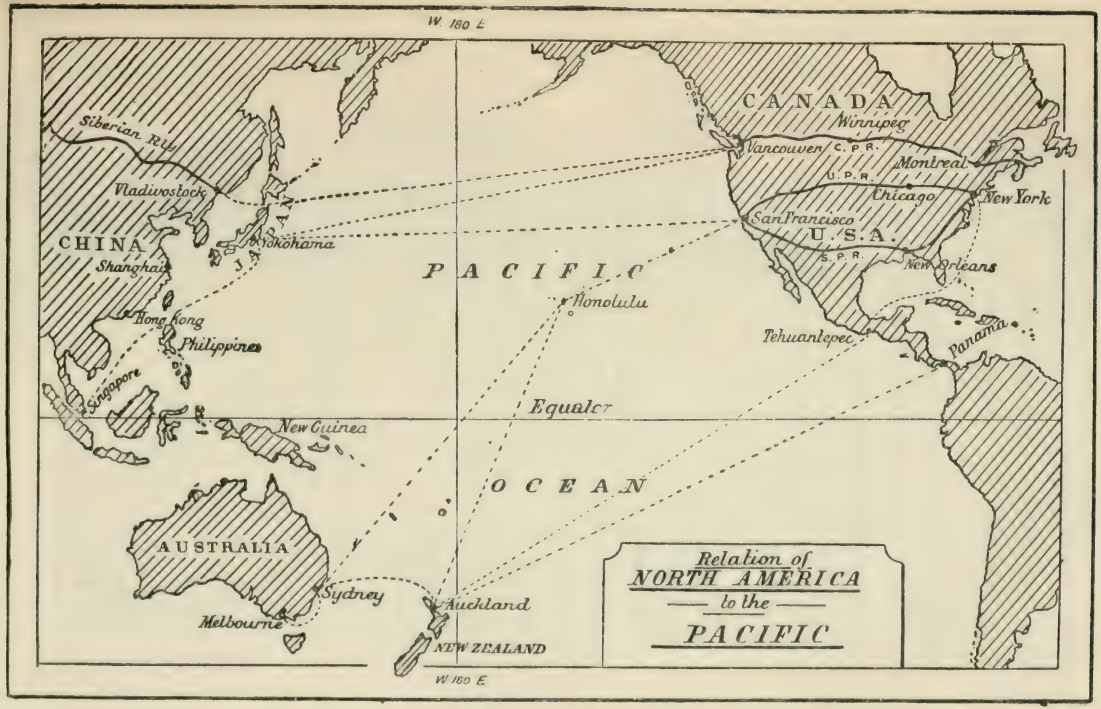


FIG. 267.—THE TRANS-PACIFIC TRADE ROUTES.

San Francisco is to the States what Vancouver is to Canada. It is not so favoured in respect of coal. Its greater size is due to the convergence of many traffic-lines on its harbour. It commands the Pacific trade between America, Japan and Australia. Earthquakes point to the unsettled condition of the mountain axes along this coast. *Los Angeles* is of comparatively little importance.

Table of Populations (for reference only) :—

[U.S.A. = United States. C. = Canada. p. = port. r.p. = river-port. Towns in the British Isles are given in italics, for comparison.]

London (county)	4,522,961
,, (with suburbs)... ...	7,253,000
New York	4,766,880 p. U.S.A.
Chicago	2,185,000 r.p. U.S.A.
Philadelphia	1,549,000 p. U.S.A.
Manchester (with *Salford*) ...	978,000
Liverpool (with *Birkenhead*)...	878,000
Glasgow	784,000
St. Louis...	687,000 r.p. U.S.A.
Boston	670,000 p. U.S.A.
Cleveland	560,660 r.p. U.S.A.
Baltimore	558,480 p. U.S.A.
Pittsburg	533,900 U.S.A.
Birmingham	526,000
Montreal...	466,000 p. C.
Leeds	445,570
Buffalo	423,700 r.p. U.S.A.
San Francisco	416,900 p. U.S.A.
Toronto	376,000 r.p. C.
Cincinnati	363,600 U.S.A.
Bradford	289,000
Newcastle-on-Tyne	267,000

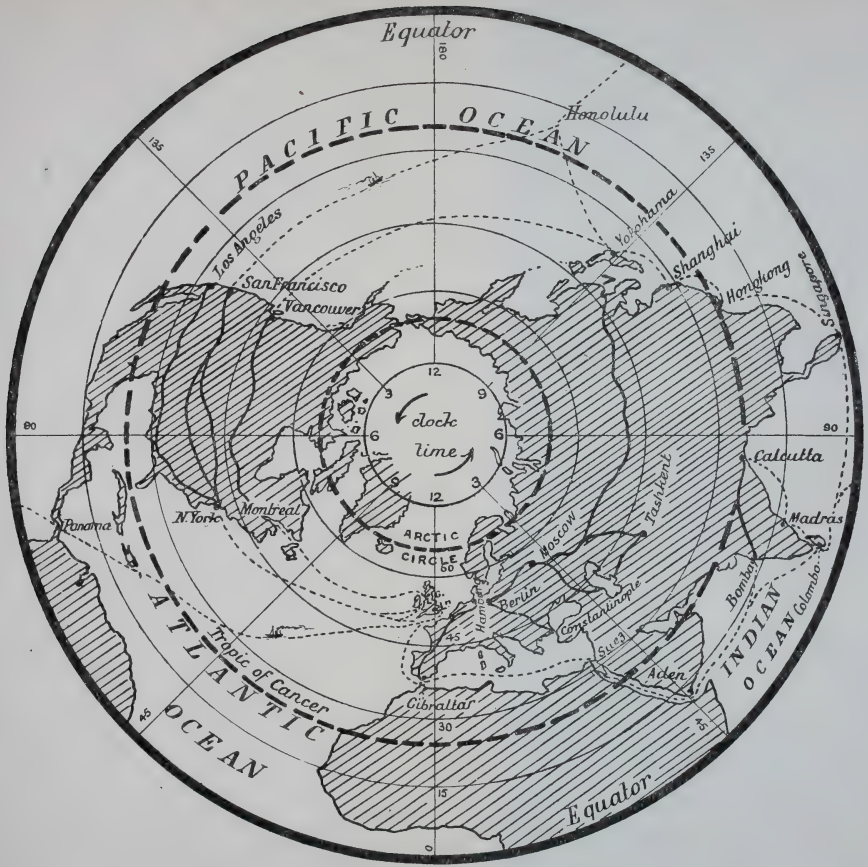


FIG. 268.—THE ZONE OF THE WORLD'S CHIEF TRAFFIC LINES. [*To face p. 486.*

[Between the dotted circles.]

PART II.

A Series of Nine Sections, giving Local Geography and Materials for the building of Sketch Maps.

The arrangement necessitates some repetition, but this is an advantage, for the facts now appear in their Local rather than in their General setting.

PART II.

THE DOMINION OF CANADA.

I.—The St. Lawrence and the Great Lakes.

AVERAGE LATITUDE 45° N. LONGITUDE 72° W.

APPROXIMATE CO-ORDINATES OF—

TORONTO: $79\frac{1}{2}°$ W., $43\frac{3}{4}°$ N.

MONTREAL: $73\frac{1}{2}°$ W., $45\frac{1}{2}°$ N.

FIRST in order of colonisation and nearest to the European continent, the basin of the St. Lawrence is the most important area of the Dominion. Moreover, it lies in close contiguity to the New England States, so far the busiest and most prosperous of the states of the Union.

The basin may conveniently be divided into *three sections*, deserving separate treatment:—

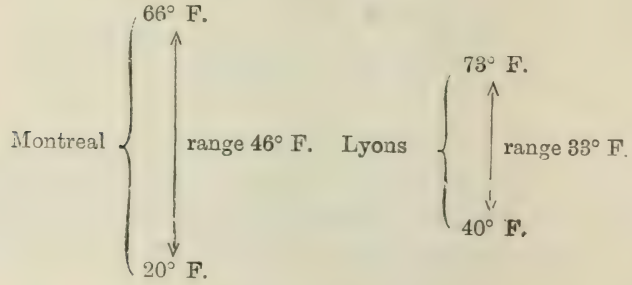
1. The Gulf Provinces.
2. The Lower St. Lawrence and Quebec.
3. The Great Lakes and Ontario.

The course of the St. Lawrence is determined by the *ancient trough* running parallel to the folds of the New England ranges, and let down between them and the crystalline plateau of Quebec. The valley leaves little room for the development of tributaries. The *Saguenay* and the *Ottawa* from the northern divide, and the *Richelieu* from *Lake Champlain*, in New York State, are the most important.

The trough expands upwards into the *plateau-basin* of the Lakes, and outwards into the wide, shallow *gulf*.

The *average latitude* is 10° further south than that of the British Isles, but the mean annual temperature is only about the same (45° F.). Summers are warmer and winters decidedly colder than in Great Britain: the estuary is *frozen for about four months* every winter. The climatic type, and, indeed, the general physical characteristics resemble those of the *Baltic Sea*, Newfoundland and Cape Breton Island making the gulf *an inland sea*.

Montreal is as far south as Lyons, and about equidistant from the sea; a comparison of summer and winter temperatures is therefore instructive.



The more *extreme climate* of Montreal is due to the fact that its winter winds blow from the north-west over a continent, and its summer winds blow from the south-west over another stretch of the North American land-mass. (*See* Figs. 13 and 14).

The tendency of the *warm oceanic drift* of the Atlantic is *away from* the St. Lawrence Gulf. On the other hand, the prevalent winds across France—again from the west, whether N.W. or S.W., or due W.—have blown across the Atlantic, and are, as a result, more equable in character, whilst at the same time the French coast benefits by the warm drift of the Atlantic laving its shores.

The valleys of the crystalline lake-plateau north of the trough are filled with *timber-trees*; the slopes of the folded ranges south of the trough are especially suited to *dairy-farming*; the lake-peninsula of Ontario, the most southerly region of Canada (Toronto is in the latitude of Marseilles) is well adapted to *fruit-farms*; the northern shores of Superior and Huron promise to develop into a rich *mining industrial* area, *copper*, *iron* and *nickel* occurring in abundance.

Montreal is the focus of industry and the terminus of railway and shipping traffic; it stands midway between north and south, east and west—between the French-Canadian Quebec and the provinces of the Gulf on the east, and the thoroughly British province of Ontario on the west.

Quebec is strongly French in character, having changed little since its capture by Wolfe in 1759. It remains the capital of the French Canadians and the principal seat of the *lumber* industry.

Toronto is the most British of the St. Lawrence cities, and the centre of the fruit farm-lands. *Sudbury* on the C.P.R. and *Sault St. Marie* on the Lake system have yet to decide which shall be the metropolis of the mining industries.

We may now consider the three sections more in detail.

(*a*) **The Gulf Provinces.**—Under this title we include *Newfoundland*, *Cape Breton Island*, *Nova Scotia*, *New Brunswick* and *Prince Edward Island*.

Newfoundland, it should be remembered, has its own Government, independent of the Dominion.

Physically, *Nova Scotia*, *Cape Breton Island* and *Newfoundland*, the Atlantic border provinces, are precisely similar. They are built of folded Primary rocks, which continue northward the *true mountain-structure* of the American Appalachian ranges. *Ribbon-lakes* occur in the hollows of the folds and *sea-fiords* creep up into the interior from the coast.

The slopes are covered with *timber* and lumbering is the chief occupation for landsmen.

The three provinces, as, indeed, the whole of the gulf region, rest on a *submerged platform*, precisely as do the British Isles. The result is that the shallow seas of the Gulf of the St. Lawrence are the home of great *fisheries*.

It was the fishing facilities that first drew French fishermen to these coasts. *Cod fisheries* are the most important and thousands are engaged in the industry. From some of the ports *sealing and whaling expeditions* set out to the North Atlantic. Though the French lost Canada in 1763, they still retain the island of *Miquelon* and *St. Pierre* on the banks south of Newfoundland, together with fishing rights between Cape St. John and Cape Ray.

Newfoundland has a more rigorous climate than Nova Scotia. It is exposed to the icy *Labrador Current*, and the *fogs* produced by the sudden meeting of cold air over the Labrador Current with the warm moist air above the *Atlantic oceanic drift*—off the promontory of Cape Race—make navigation dangerous. *St. John's*, the capital of the island, has a fine harbour, and is little more than three days' sail from Cork. Steamers, however, make little use of it, for in summer they can get through the *Strait of Belle Isle* to the St. Lawrence ports, and in winter, when the Gulf is ice-filled, they use *Halifax* or *Portland*, both of which are connected by trunk lines with Montreal.

Cape Breton Island is nearly severed in two by inlets, and the peninsula of **Nova Scotia is** nearly an island (pen-insula) owing to the penetration of the funnel-shaped *Bay of Fundy* whose *tidal bore* is the highest known, sometimes rising as much as 70 feet. *Sydney* is the capital of the island and *Halifax* the capital of the peninsula.

Halifax is now an important terminus, and has a still greater future in store; in addition to being the real *Atlantic*

terminus of Canadian railways, it is developing *iron* industries by aid of *coal* from the mines of Pictou on the isthmus. An outlying patch of coal occurs on the southern coast of Cape Breton Island.

New Brunswick and Prince Edward Island occupy the basin between the *Gaspé promontory* and the *Nova Scotia* mountain system. The mainland province slopes down from the sandstone range of the Gaspé to the *Bay of Fundy* (never frozen) on the south and the land-locked, winter-closed *Gulf of the St. Lawrence* on the north.

Detached from the mainland by the *Northumberland Strait* is the horizontally-bedded New Red Sandstone island of *Prince Edward.*

The *St. John*, the only river of importance in the basin, drains to the open Bay of Fundy. *Fredericton*, the capital of New Brunswick, stands on the river, and *St. John* is the outlet-port.

A *coalfield* occupies the northern coast of the province, extending from *Bathurst* as far as *Cape Breton Island.* It stretches into the interior as far as the *St. John River.* A railway traverses the field, and links its mining centres with the markets of *Halifax*, *Quebec* and *Montreal.*

Prince Edward Island, of similar physical structure to the Vale of York or the Basin of the Trent, has been called the "Garden of Canada." *Charlottetown*, on the Northumberland Strait, is the capital.

Apart from *coal-mining* and its attendant industries, the province and its off-lying island are given over to *dairy-farming.* French peasants outnumber British by at least five to one.

(*b*) **The Lower St. Lawrence and the Province of Quebec.**—A student of the map of Canada cannot fail to notice the *use of physical features as provincial and political boundaries.*

Rivers are more often used than *mountain-walls*, owing to the greater definiteness of boundary afforded. Where no physical feature can serve, the use of *longitude and latitude lines* is predominant on the North American continent.

The French Canadian province of Quebec is limited on the south by the river *Ottawa*, on the west by a line of *longitude* (79½° W.) extending from the Ottawa to *James Bay*, on the north by *two streams*, draining in opposite directions—the *East Main river* to James Bay and the *Hamilton river* to the Atlantic; a line of *latitude* (45° N.) links the river-frontier of the *St. Lawrence* with the mountain-wall boundary east of the St. Lawrence trough.

The long island of *Anticosti*, obstructing the entrance to the St. Lawrence, is an unpopulated sand bank.

The large **Province of Quebec** thus lies chiefly north of the St. Lawrence extending back on the crystalline plateau as far as *James Bay* and the inhospitable lands of *Labrador* and *Ungava*, with a river and gulf frontage from *Montreal* to the *Strait of Belle Isle*. It includes the slope of the *Gaspé range* on the right bank from a point just above Montreal to the Gaspé promontory. Its area is double that of France. The lake-plateau north of the St. Lawrence is the exact counterpart of *Finland*. The average altitude is 1,200 feet; innumerable lakes fill the hollows of the crystalline rocks; parallel streams run off the edge of the plateau to join the St. Lawrence. *Ungava* has just been added to the province.

Timber is plentiful, and probably, as in Finland, *iron* abounds, though as yet it remains undiscovered and unworked in this eastern province of the basin. *Quebec* is the gateway of the lumber export; saw-mills and pulp-factories occur at the outlet of every lateral valley. The *Saguenay* estuary is less liable to freeze than the St. Lawrence, its waters being more brackish; it provides excellent anchorage and it has therefore been suggested to create *a new railway terminus* at the

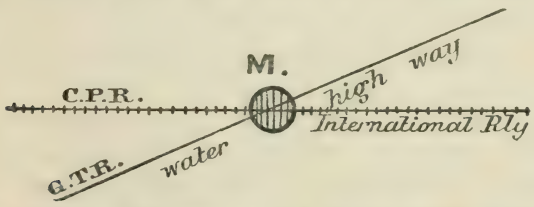
mouth of the Saguenay, the railway to cross the forest and iron-ore belt by the shortest line to Winnipeg.

The *trough from Quebec to Montreal* (and indeed to Lake Ontario) is floored with Silurian rocks (like those of Wales or Cumberland) overlain with *rich alluvium*, left by the retreat of the estuary. This horizontal floor is very productive, and is given up to mixed farming, *i.e.*, pasture, tillage and market-gardening.

Quebec is the historic town and mother-city of the province and the approach by steamer is magnificent. Strongly fortified, it looks down from the Heights of Abraham upon the busy river. It is the most French of any town outside France. 85 per cent. of the people being French and Roman Catholic; it is therefore the real capital of the French-Canadian who is chiefly found from Montreal to Pictou and the country of Evangeline. It was founded by the French in 1608, and captured by Wolfe in 1759.

Three Rivers, midway in the alluvial trough, where two lateral streams join the St. Lawrence from opposite banks, is the outlet of the *St. Maurice* valley.

Montreal (Mont Régal—the royal mountain), so named by the French in 1642, is built around a *volcanic plug* rising out of the *alluvial flats* of an island at the confluence of the



Ottawa and the St. Lawrence. It is the largest city of the Dominion, possessing unique advantages of railway and river transit, including the St. Lawrence valley and the *Hudson depression*, leading direct and due south to *New York*. Its population numbers about half a million. The French

element again predominates, though it is necessarily the most cosmopolitan of Canadian cities.

(*c*) **The Great Lakes and Ontario.**—The irregular and extended **Province of Ontario** has the Great Lakes for its boundary on the south. Three river systems serve as political frontiers—the *Rainy* and *Pigeon* rivers and lake-chain draining to Lake Superior and the Lake of the Woods, the *English* and *Albany* chain of lakes and streams draining to Lake Winnipeg and James Bay, and the *Ottawa* finding its way to the St. Lawrence. Most of the drainage is *away from the Lakes*, for the "*Height of Land*" on the plateau runs parallel to and not far from the northern shores of *Superior* and *Huron*.

The province has lake-frontage on all the Great Lakes, except *Michigan*, which is entirely within United States territory. The fertile tract corresponds with the sedimentary rock *lake-peninsula* jutting south-west between *Lakes Huron* and *Erie-Ontario*. The crystalline plateau extends westward from Labrador and Quebec, and southward from Hudson Bay to the shores of *Lake Superior* and the Georgian arm of Lake Huron. The railway from *Parry Sound*, on *Georgian Bay*, to *Ottawa* marks off the plateau-region from the sedimentary facies. *Lake Ontario* lies in a basin of ancient clays banded with limestones (one of which is the Niagara Limestone); *Lake Erie* is held in a basin of Old Red Sandstone, the chief store-house of *petroleum*; the fertile region corresponds with these two lake basins.

At present the population is aggregated on the lake-peninsula, enclosed by the Lakes, the Ottawa and the St. Lawrence. *Fruit-farming* is here more successful than elsewhere in Canada. Some mixed farming is added. Agriculture is specially encouraged from the State College at *Guelph*. Means of transit are plentiful. Steamers ply on the lakes and the *Canadian Pacific Railway* runs from Montreal keeping south of the "Height of Land" to touch Lake

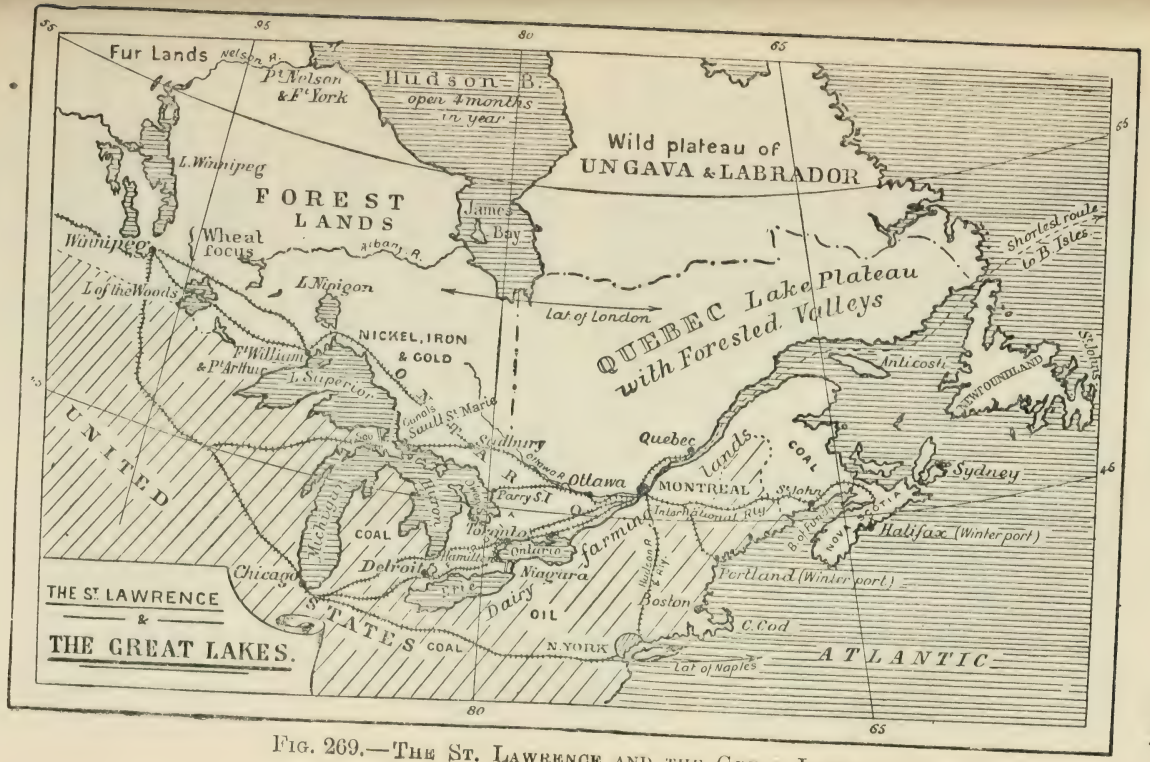


FIG. 269.—THE ST. LAWRENCE AND THE GREAT LAKES.

Superior at *Heron Bay* on its course westward across the continent. The *Grand Trunk Railway* follows the Laurentian trough to *Detroit* on the States side of the frontier, calling at *Kingston*, *Toronto* and *Hamilton* (all on Lake Ontario).*

Lines branch from *Ottawa*, on the C.P.R., and from *Toronto*, on Lake Ontario, to the lake ports on Huron, *Parry Sound* and. *Owen Sound*, both on the Georgian Bay. Lake navigation has been greatly enhanced by the canalisation of the *Sault St. Marie* rapids and the *Niagara* bluff.

The "Soo" (pronunciation of Sault) canals, *one* on the Canadian side and *two* on the American side, together with the International Bridge, linking Canadian with States railways, across the rapids, will do much to make *Sault St. Marie* one of the most important distributing and manufacturing centres in Canada. It should rapidly out-distance *Sudbury*, which stands back from the lakes. The *Welland Canal*, across the Niagara peninsula, gives direct passage from the lakes to the St. Lawrence.

The head of lake navigation on the Canadian side is *Port Arthur*, with its neighbour *Fort William*. Here we touch upon the great *wheat-growing region*, of which Port Arthur is the eastern gate. It is instructive to contrast the climate of the plateau between the Lakes and Hudson Bay with that of the fertile peninsula around Toronto.

Port Arthur	66° F. Summer Isotherm. 10° F. Winter Isotherm.	Toronto	68° F. 22° F.
	56° F. range.		46° F.
	Average t° 38° F.		Average t° 45° F.

Port Arthur is in the *latitude of Paris* (average t° 52° F.); *Toronto* in the latitude of *Marseilles* (average t° 60° F.).

The *plateau* and the *plain* differ widely in nearly every way. Climate is more rigorous on the plateau, while fertility

* N.B.—The principal towns on Lake Erie ("oil" towns) are on the States side of the lake.

is considerably less; thus far, population depending on fertility, the peninsula has been the most densely peopled area in Canada. But the plateau is now discovered to be rich in mineral wealth. *Iron* of excellent quality, *copper-ores*, and, most remarkable of all, *nickel*, which usually accompanies copper, is here more plentiful than in any other known area. The richest area is that of *Algoma*, between the two important transit lines, the C.P.R. and the Lakes. *Sudbury* and *Sault St. Marie*, on railway and lake, are the inevitable centres of mining development. *Coal* is lacking, but easy of shipment from *Cleveland* and *Detroit*, on the States side of the Lakes. *Timber* is plentiful and available for smelting. It is therefore possible that population may shift from the overcrowded peninsula to the mining centres on the plateau.

Toronto is the largest city of the province. In the most British of Canadian provinces it is the most British of Canadian cities. It is about three-fourths the size of Montreal.

Ottawa is the seat of the Dominion Government; it is linked with Lake Ontario by the *Rideau Canal*.

London stands in the midst of the fruit farms of the fertile peninsula. The great lakes of the plateau constitute the greatest body of fresh water in the world. They recall the precisely similar great lakes of *Finland*. Lake transport is so important (wheat and minerals) that the tonnage of vessels using the "*Soo*" *Canals* in a year exceeds that of the vessels using the Suez Canal. *Parry Sound* is the lake port for Ottawa and Montreal. *Owen Sound* similarly serves Toronto; by them tourists avoid the roundabout voyage by *Detroit*. Lake-steamers of special construction can now carry wheat from Port Arthur to Manchester. From Port Arthur to the Straits of Belle Isle is about as far as from Belle Isle to Manchester.

The shores of *James Bay* are swampy and only frequented by the trapper.

II.—The Dry Interior of the Dominion: Wheat-lands and Cattle-ranches.

Approximate Co-ordinates of Winnipeg: 97°W. / 50°N.

The student has previously noted in Chapter II. the *chain of lakes* which runs parallel to the curve of *Hudson Bay*. Between this definite chain and the long mountain-wall of the Rockies, and extending in Canada to the *United States frontier*, we have a very marked geographical unit of the Dominion.

Whilst the belt between the chain of lakes and Hudson Bay is an exposed area of fundamental ancient crystalline

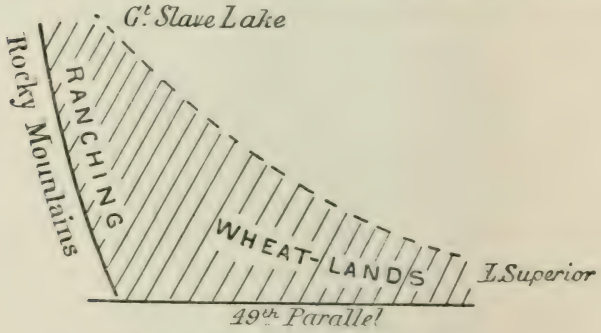


Fig. 270.—The Dry Interior.

rocks, rich in granite and other igneous rocks, as well as in ores of the valuable metals, and covered in many places with forests of fir and spruce, the triangular area defined for consideration in this section is covered with *loose sedimentary rocks* of Secondary down to Recent age, which lie upon the fundamental crystallines.

In these rocks *mineral wealth* is scarce.* Development depends on fertility. The varied facies of Secondary and later sediments (clays, soft limestones, sands and gravels) when admixed by coalescing streams and distributed over flood plains, or on the floors of lake-basins, give rise to soils of the greatest fertility.

Rainfall is, however, a necessary factor to productiveness. The region outlined is the *driest* of any part of habitable Canada. More rain falls here, however, than in the great *Colorado Basin*. Thus, whilst the latter is practically desert, the *Canadian interior* is one of the richest agricultural regions on the continent. The *rainfall* averages 15 ins. a year, whilst that of Nova Scotia attains to 50 ins. a year.

In so *dry* a region one naturally expects *extremes of climate*. The July isotherm is 70° F., equal to that of *North Spain*. The January line is 0° F., or 32 degrees of frost, equal to that of *Greenland* or *Nova Zembla*. The range between summer and winter is therefore as much as 70° F. (average for the area), whereas in *Great Britain* the average range is only 20° F. Next to *Siberia*, we find here the most continental of climatic types.

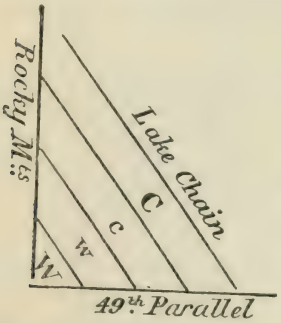


FIG. 271.—TEMPERATURE BELTS.

But the S.W. corner of the triangle is much more genial than the S.E., being nearly twenty degrees warmer in the winter. The belts of climate run *diagonally*, as shown in Fig. 271. The great heat of summer is accounted for by the *long days* and the *absence of rain*. Seventeen hours' sunshine a day is common in July, and with such a climate a *three*

* Important coal-deposits, however, are now being worked.

months' season is long enough for wheat-growing. The intense winter cold harms nothing, but rather helps the soil by freezing the water which has soaked into it, and so crumbling the ingredients.

The *wheatlands* in belts C and c of Fig. 271 are becoming the granary of the Empire. *Ranching* is characteristic of the warmer belts at the foot of the Rockies. The province of **Alberta** is occupied by foot-hills, and so less suitable for the plough than the flat provinces of **Manitoba** and **Saskatchewan.**

The rivers of the region drain mostly to the *Hudson Bay*, which would be an ideal outlet but for its winter-ice.

Port Churchill is thirty miles nearer Liverpool than New York is, and the transit could all be made by water, so avoiding heavy freight-rates by rail.

The *Nelson River* and the *Churchill river-and-lake-system* would develop into lines of navigation; the ports at their mouth would grow into oceanic ports.

Port Arthur must, however, for the present, serve as the port of the productive interior. The huge grain-elevators, capable of storing 7,000,000 bushels of wheat, proclaim the port of *the Empire's granary.* The alternatives are lake-navigation or rapid transit to the wharves of *Montreal* by the C.P.R.

Winnipeg, 550 miles west on the railway is the *exchange* or bourse of the cornlands. In fifty years it has grown to a town of fifty thousand inhabitants.

Brandon, in the midst of the best wheat country, is the farmers' centre.

At *Winnipeg*, *Regina* and *Swift Current* the main line throws off tentacles to gather up the produce of the harvest. These latter branches extend further north-west along the temperature-zones as year by year fresh land is broken up by emigrants.

The line from Winnipeg has gained *Fort Churchill* by way of the *Nelson Valley.* The other lines extend to the *Sas-*

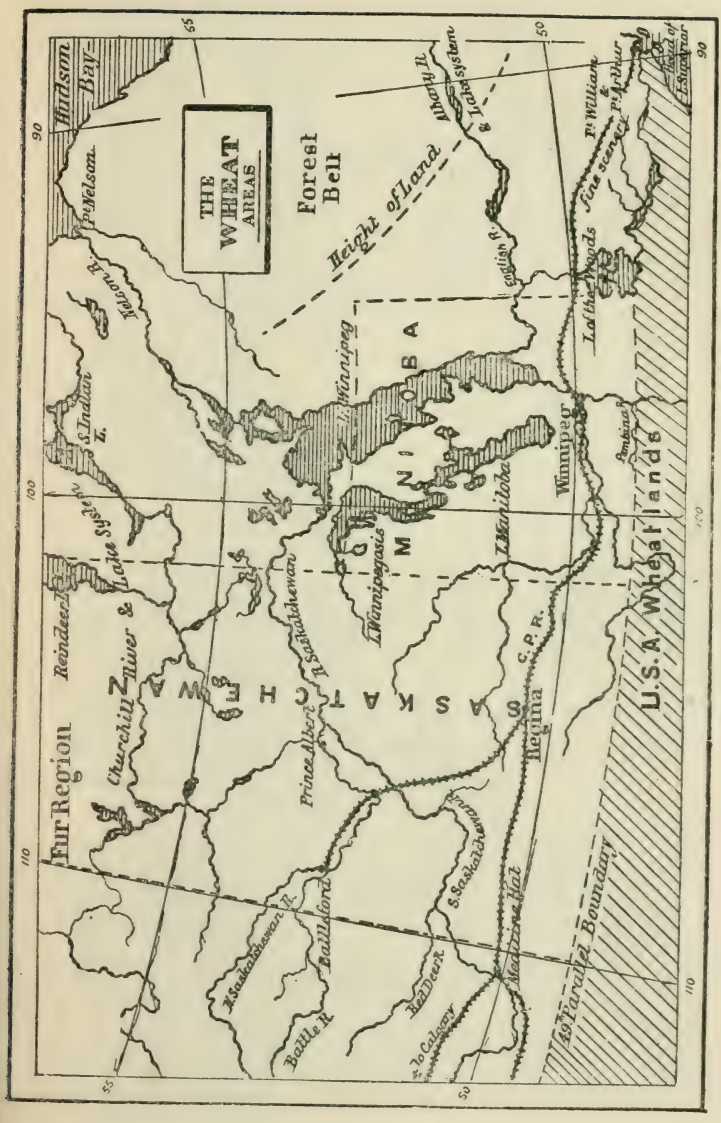


FIG. 272.—THE WHEAT AREAS.

FIG. 273.—THE RANCHING AREA OF ALBERTA. (*In the* **rain-shadow** *area of the Rockies.*)

katchewan waterway. Both the Saskatchewan and the Churchill valleys will very shortly be traversed by cross-continental lines converging upon *Prince Rupert* on the *Dixon outlet* to the *Pacific.* The development waits the exploitation of *gold-fields* in the Rockies and the ploughing of *wheat-lands* in Athabasca, no longer a separate district. (*See* Figs. 272 and 273).

At *Medicine Hat*, where the line forks before crossing the Rockies to Vancouver, we approach the foothills of the great range and enter the *ranching country.* Alberta is world-famed for horse and cattle-rearing.

As we have already noted, the province is warmer than the wheat territories. It is sheltered by the mountains, and in winter the cold is tempered by the *warm south-west wind*, which blows through the passes of the Rocky Mountains from the Pacific Ocean (*see* Fig. 256). Coming from the land of the Chinook Indians, this genial wind is called the *Chinook.* As a result of this wind, snow seldom stays on the ground for more than three days at a time.

The country is well-watered by *glacier-fed* streams from the Rocky Mountains. Some of the giants of the range overlook this province (*see* Fig. 273). The main line of the Canadian Pacific Railway negotiates the Rockies by means of the *Kicking Horse Pass.* It enters at *Banff*, a tourist centre with a National park, and emerges at *Donald*, on the Columbian side and at the foot of the towering peak Sir Donald.

Calgary is the ranchers' capital and the railway focus of Alberta.

Fort McLeod, due south, on the minor fork of the C.P.R. and at its intersection with the *South Saskatchewan* river, is another transit-centre.

The *minor fork* of the railway crosses into British Columbia by way of the *Crow's Nest Pass*, in the *Kootenay* district.

Edmonton is the northern limit of the ranchers' railway; he calls it his station for the North Pole, being the most northerly railway station in the Dominion. Nevertheless, it is only in the latitude of Leeds.

III.—The Canadian Rockies and the Pacific Seaboard.

Approximate Co-ordinates of Vancouver City: 123° W. / 49½° N.

The *Rocky Mountains of Canada* are more truly a *complex folded system* than the Rockies of the United States. The block-structure of the Colorado country, enclosed between the inner and outer mountain walls of the States, is practically absent in British Columbia. The cordillera of the Canadian system is a complex of crystalline, sedimentary and igneous rocks crumpled into folds of immense altitude, denudation not having had time to wear down the system, as it has reduced the folded ranges of the Appalachian system on the Atlantic seaboard. The cordillera is young, geologically speaking; hence the absence of smooth, rounded summits and axes—Nature has yet to rub the angles down. *British Columbia* is therefore a country of lofty *peaks* (Eng.), *aiguilles* (Fr.), *horns* (Ger.), outrivalling the Alps in grandeur and gloom. The cordillera approaches the coast and leaves *no room for a coastal plain*; the formation of lateral valleys and the sinking of the seaboard has given rise to a *fiord-cleft coast*, with a *skerry-fence* of islands precisely similar to the rock-bound shores of Scandinavia.

Types of Physical Features:—

(*a*) *Parallel ranges*, with *trough valleys*.

(*b*) Only the *highest range* uncleft by lateral valleys—the few passes (*e.g.*, those used by C.P.R.) are the exceptions.

(*c*) Drainage to coast from culmination gives *lateral* valleys by cutting through gaps in the lower ranges.

(*d*) The *fiords* and *sounds* are sea-filled valleys, their zigzag form being due to the coalescence of longitudinal and lateral valleys.

The ranges of the cordillera present their flanks almost *normally* to the rain-bearing winds from the Pacific. The outer seaboard range, called the *Cascade Range* from the number of streams which fall over its ledges on their swift course to the sea, is of sufficient altitude to lead to *intense precipitation*, with a result that the seaward slope is the rainiest belt in Canada, or, indeed, in the whole continent outside the tropics. The winds have been considerably tapped before they reach the main range, so that in a short distance of 100 miles the rainfall lowers from 80 ins. on the *west slope* of the Cascade Mountains to 20 ins. on the *inward slope* on the "rain-shadow" side of the range.

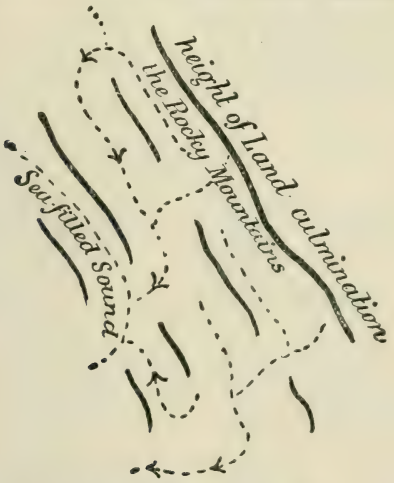


FIG. 274.—ZIG-ZAG VALLEYS.

The *gap at Vancouver*, by which the waters of the *Fraser* empty into the *Georgian Strait* and the outlet Strait of *Juan de Fuca*, allows the rain winds access to the valley, with the result that this basin is a *local area of exceptional rainfall* (average 40 ins.).

The interior of British Columbia is thus not so rainy as is generally supposed; indeed, the *Kootenay region* is called the "*dry*" *region* of the province, and *fruit-farming* has been suggested.

British Columbia is as yet largely undeveloped, but her resources must before long lead to vast strides in colonisation. As far north as *Dixon Entrance* the coast is in the hands of Canada, and the *hinterland* is rich in *timber* and *minerals*. The estuaries abound in *salmon*. The off-lying islands have valuable deposits of *coal* (of Secondary age).

The Strait of Juan de Fuca and the Dixon Sound afford excellent anchorage and are never frozen. The former is already Canada's "sunset doorway of the Dominion," while the latter promises to rival the Vancouver passage when the proposed trunk lines across the northern wheat-lands cross the Rockies to reach *Prince Rupert*.

The summer and winter isotherms, which intersect at *Liverpool*, also intersect at *Vancouver*; such a fact reveals the average character of the climate in the *south* of the province and points a striking contrast to the climate of *Winnipeg*.

Vancouver	Summer	60° F.	Winnipeg	Summer	68° F.
	Winter	40° F.		Winter	5° F.
	Range	20° F.		Range	63° F.

The *difference in rainfall* will explain the *difference in range of temperature* of the two towns.

The Rockies are the only region where a *mountain flora* occurs.

The slopes of the ranges are clad in forests of *Douglas spruce* and *white cedar*.

The middle ranges of the Cordillera, occupying the catchment area of the *Fraser* and *Kootenay* rivers, have many igneous rocks, and are rich in *mineral-ores*; *gold* and *copper* are the principal metals; *silver-lead* ores also occur.

The *Nanaimo coalfield*, on the inner slope of the island of *Vancouver*, and the similarly placed coalfield of the *Queen Charlotte Islands*, await development.

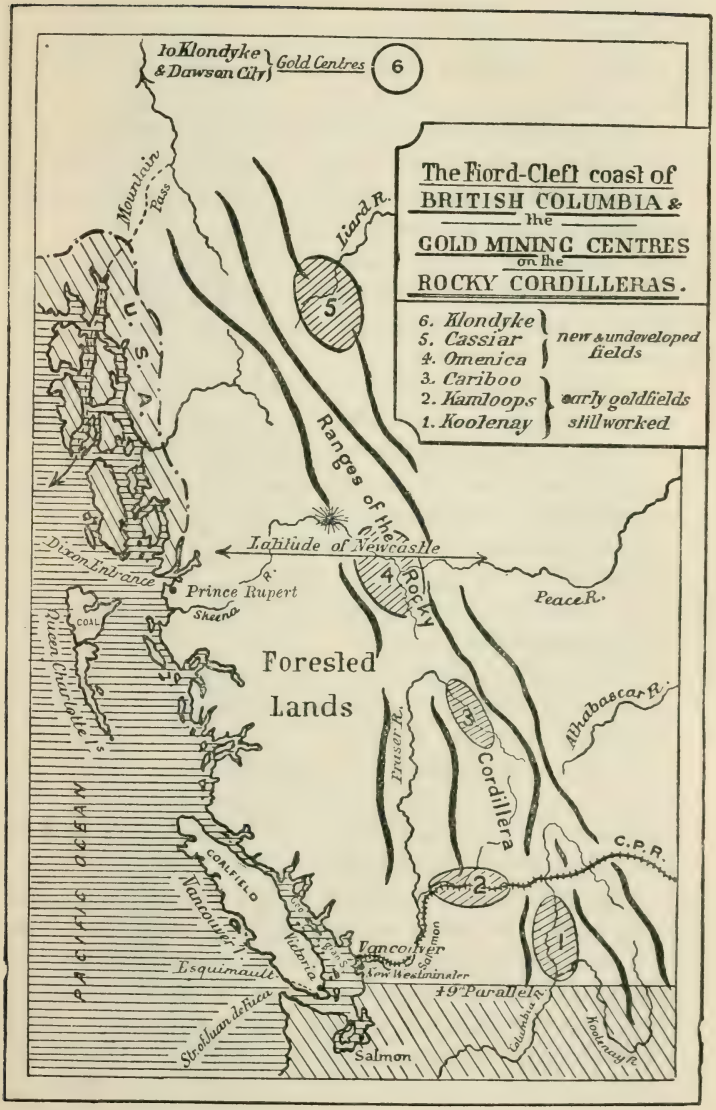


FIG. 275.—THE FIORD-CLEFT COAST OF BRITISH COLUMBIA AND THE GOLD-MINING CENTRES ON THE ROCKY CORDILLERAS.

Timber is available for building, pulp-making and smelting industries.

Salmon fisheries have led to 50 canning centres on the Fraser River.

Prince Rupert may be expected to develop, not only as a commercial gateway, but also as a base for *whale and seal fisheries*, the coast north of the Dixon Entrance being the chief home of the valuable fur-bearing seal.

Placer-gold, in the sands of the *Fraser River*, first attracted prospectors and miners to British Columbia. The quartz reefs in the hill-sources are now being quarried, and the ores crushed.

Copper-ores have been discovered to be plentiful, and are being worked by American plant and American miners in the Kootenay region, on the southern fork of the C.P.R.

Nelson and *Rossland* are important centres. *West Robson* is the centre of lake and railway transit.

The ribbon-like *Arrow Lakes* are expansions of the *Columbia River* in these mining valleys.

Arrowhead is connected by rail with the main fork of the railway at *Revelstoke*.

The *Kamloops goldfield* is in the valley of the *Thompson* affluent of the Fraser. The *Cariboo goldfield* is at the source of the main river.

The *Omineca goldfield* is in the lake-country around the head streams of the *Skeena*. Its inevitable outlet is *Fort Simpson*, which must also serve the *Cassiar gold-mines*, on the northern (60° N. lat.) frontier of the province.

Vancouver City, at the mouth of the Fraser (whose quota to the world's production is made up of timber, salmon and gold), at the western terminus of the Dominion's highway, with splendid anchorage and a gateway to the broad Pacific, is the focus of British Columbia. *New Westminster*, *Port Victoria* (the out-port and rival of Vancouver) and *Esquimalt*

(the head-quarters of a British squadron), all join in the activities of import and export.

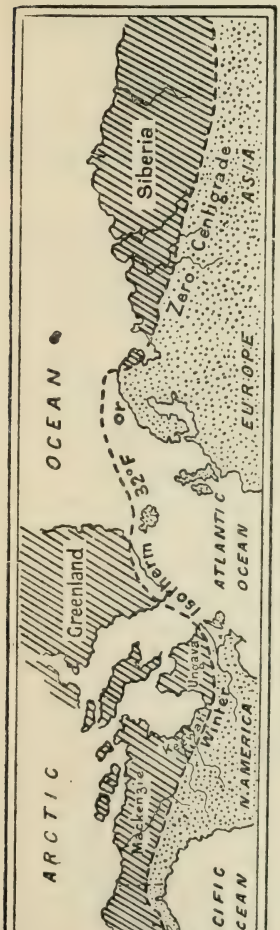


FIG. 276.—THE GEOGRAPHICAL ARCTIC ZONE.

The *goldfields of Yukon*, around the sources of the mighty Alaskan river of the same name, are within British territory. *Dawson City*, a town of shanties, with a summer climate as warm as that of *Leeds* and a winter temperature little colder than that of *Winnipeg*, is the centre of the *Klondyke* mining operations. The river is navigable for 1000 miles, but *Dyea* is the natural outlet of the region. It is a United States station. Passes over the Rocky Mountains afford access from port to goldfield.

IV.—The Frozen North.

THERE remains to be considered the *frozen belt* of Northern Canada. A land of *mighty rivers* and *innumerable lakes*, its drainage is all to the *Arctic Seas*. Frost-bound for the greater part of the year, *poor in rainfall*, it offers no temptation to the agricultural settler. The coastal belt is covered with *tundras*, frozen swamps, which, under the heat of the long summer days (the Arctic Circle

bisects the belt), have a surface of mire less desirable than the hard winter soil.

Trapping for furs from the elk, the moose and the beaver is the only inducement to penetrate this region.

Timber is available; minerals remain unexplored.

Fort Churchill is the rendezvous of fur traders. Red Indians and Esquimaux here foregather to barter with the European trader.

The great bay, named after its discoverer *Hudson*, is twice as large as the *Black Sea*. But it falls entirely within the Arctic belt. It affords the supreme *climatic contrast* to the other great bay of the North American Continent—the *Gulf of Mexico*.

Fig. 276 suggests many comparisons with *Arctic Siberia*.

THE UNITED STATES.

I.—The Atlantic States.

APPROXIMATE CO-ORDINATES OF—

NEW YORK: 74°W. — 41°N.

PITTSBURG: 80°W. — 41°N.

CHARLESTON: 80°W. — 33° N.

THE original *British colonies*, thirteen in number, which afterwards united to form the independent republic of the United States, were all situated along the Atlantic seaboard. To the north the parallel ancient ranges of the Appalachian system approach nearer and nearer to the sea, eventually affording sea-filled valleys and island-ranges, but no coastal plain. To the south the ranges extend obliquely back from the coast, leaving a broadening coastal plain, which merges with that of the Gulf of Mexico. Climate amid the ranges of the north suited the British colonist better than the warmer, damper climate on the plain to the south.

The French were in possession of the St. Lawrence, and had pushed well into the continental interior *viâ* the Mississippi when Raleigh planted the first colony of *Virginia*, in 1584, naming it in honour of Queen Elizabeth.

Some thirty-six years after Raleigh had set up the British flag on the North American Continent, the *Pilgrim Fathers*, driven by religious persecution, settled at Plymouth (which they named after the English port from which they had sailed in the *Mayflower* in 1620). From this small beginning sprang the "*New England*" *colonies*, to this day foremost among

American States. These colonies are now represented by the States of *Massachusetts* ("Great Hills"), *Rhode Island* and *Connecticut*. Subdivision gave *New Hampshire* (one of the original States), *Maine* and *Vermont*.

The New England States lie N.E. of the *Hudson Valley*. This valley has throughout the history of North America been a line of great strategic as well as (latterly) commercial importance. It affords the best access through the mountains to the interior (*viâ* the Mohawk branch) and to Montreal, one of the strongest positions of the French on the St. Lawrence in the sixteenth and seventeenth centuries, and to-day the largest city in Canada. At the entrance to the Hudson Valley, in a commanding position, the *Dutch* had planted a colony about the time of the settling of the Pilgrim Fathers at Plymouth.

By 1660, the whole Atlantic seaboard from Florida to Maine, with the exception of the Dutch Settlement, was British A struggle was inevitable, and whilst Great Britain and Holland were embroiled in war at home, the British colonists defeated the Dutch, and by the Treaty of Breda, signed in 1667, *New Amsterdam* became *New York*.

1681 saw the foundation of *Pennsylvania* by William Penn, the Quaker, on territory lying between Maryland (a colony similar in origin to Virginia and the proprietary colonies of the South) and the recently acquired territory at the gateway of the Hudson. It was from *religious* and not from *commercial* motives that Penn and his Quaker companions migrated.

The States of *New Jersey* and *Delaware* were among the original thirteen.

The year before New Amsterdam was captured saw *Carolina* founded (1663) in the *mercantile* interests, to be afterwards divided into North and South Carolina respectively. *Georgia* obtained its charter, in 1732, from George II. It extended from the Atlantic back to the mighty Mississippi; the *Spanish* colony of *Florida* cut it off from the Gulf of

Mexico. This latter became United States territory in 1821. The thirteen original colonies practically became the United States on Independence day, July 4th, 1776. The union was completed in 1783 by the Treaty of Versailles. As colonies, they had been exploited by the home-country for trade purposes. The independent spirit of the religious emigrants of the northern colonies; resentment at the non-recognition of their claim for taxation to be accompanied by representation; and the short-sighted policy of coercion adopted by the king and his ministers led to the War of Independence and the founding of the Republic.

It is most convenient, for geographical purposes, to divide the Atlantic States into NORTH and SOUTH. The contrast between north and south is very marked, not only in physical *structure*, *climatic* conditions and consequent *productions*, but also in *social* and *political* matters. The importation of slaves from West Africa to the plantations of the sub-tropical states gave eventual rise to the *Slave Question*, which involved North and South in *civil war* (1861-1865). The victory of the North put an end to slavery within the United States.

Virginia, the earliest plantation, belongs on every ground to the South, though it gave to the North its most famous general and to the States their most illustrious President, George Washington.

(*a*) The Mining and Manufacturing North Atlantic States.

The North Atlantic States are the *most British in character* of all the States of the Republic. They lie on the average *10° nearer the Equator* than our islands, and roughly from 70° to 80° west of the longitude of Greenwich. They are filled with the *parallel ranges* of the Appalachian system, the different unit ranges taking different names in different States. Practically no room is left for a coastal plain; *drowned valleys*, affording fine estuary-harbours for ships, are common. The ranges nearest the coast are

oldest and *crystalline* in many places, yielding *granite*. Metals are rare. The inner ranges are rich in *coal*; the coal has, however, been converted to *anthracite* in the mountain-folding processes, as in our own coalfield of South Wales.

The folds gradually diminish toward the interior, until they disappear in the *horizontal* sandstones and coal measures of the *Ohio-Alleghany plateau*, which extends to the Erie-

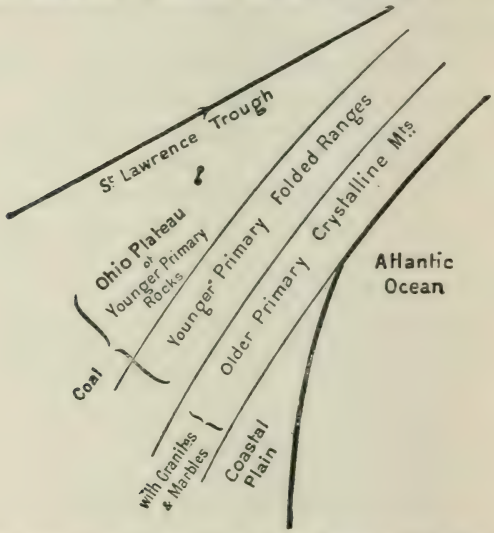


FIG. 277.—STRUCTURE OF THE ATLANTIC STATES.

Ontario lake system. Here the coal is unconverted and of the ordinary household *bituminous* quality.

The porous sandstones of the plateau lying beneath the coal are rich in *petroleum* and *natural gas*. The oil is of better quality than that of most petroleum-areas and exists in enormous quantity. Gas is less plentiful, but can be collected and used for lighting purposes. The oil and gas would appear to be products of destructive distillation of carbonaceous beds. *Iron* accompanies the coal, but is more plentifully supplied from States north of, and beyond, the Ohio.

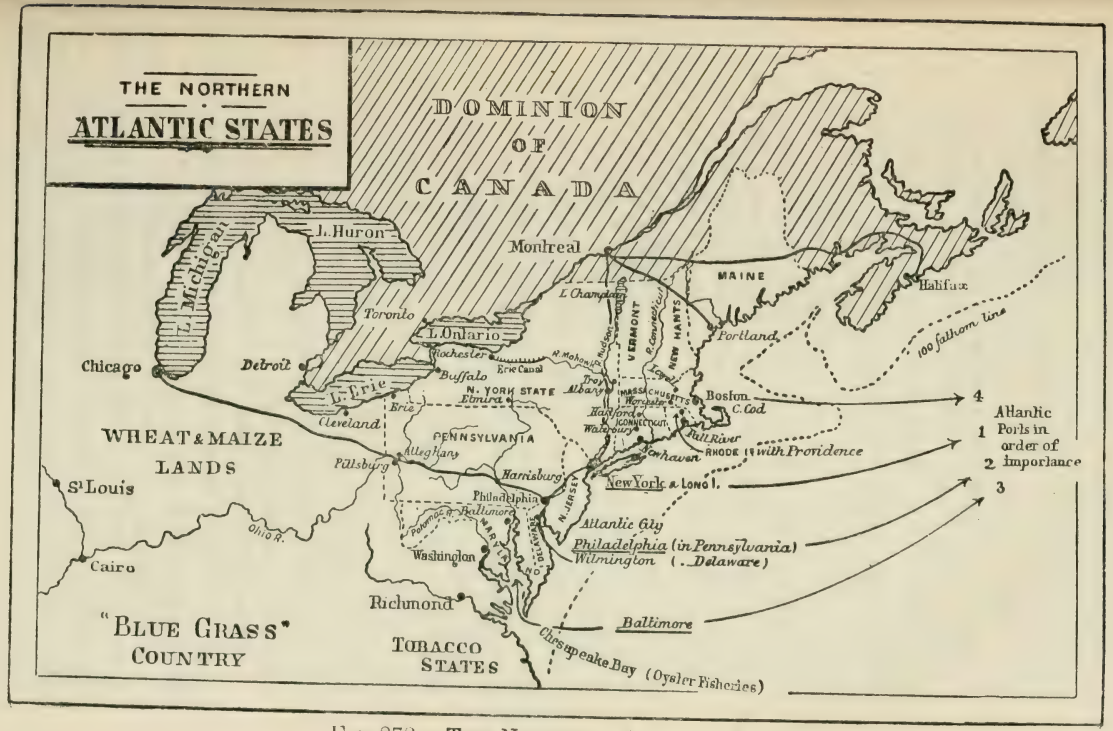


FIG. 278.—THE NORTHERN ATLANTIC STATES.

The **North Atlantic States** have thus a good supply of building stones (granite and the New Red Sandstone of the Connecticut Valley), oil, coal and iron—the foundations upon which great industries may be built. The climate is *cyclonic* in type; the States lie in the track of a prevalent series of cyclones, which often reach the British Isles. Hence we often prognosticate, with more or less success, our own weather from reports of that at New York. The *average winter temperature* is 10° F. below that of the British Isles, whilst *summer* is quite 10° F. hotter. The *annual range* is thus about 20° F. in excess of that of our islands. The reason is not far to seek. The *Gulf Stream drift* scarcely affects these States, whilst a cold current from frigid *Labrador* creeps around the island of Newfoundland, carrying icebergs to these warmer latitudes. The prevalent *cyclones* coming from a continental interior will enhance the heat in summer and intensify the winter's cold.

Rainfall is greater along the seaboard than on the Alleghany plateau, corresponding respectively to the rainfall in the west and south of England.

Forests clothe the uplands and much timber has been cut. The most northerly State of Maine remains richest in timber.

Pastures cover the hill slopes and mixed farming is carried on in the valleys, much as in the mother country. Over on the *Ohio plateau*, where summers are *warmer and drier*, *maize* is cultivated for the fattening of hogs. *Wheat* and *buckwheat* are also cultivated.

Boston, New York and Philadelphia are the three great gates to the Northern States, and they stand for the three most important States.

Boston is the chief city of Massachusetts, and rivals Liverpool in size. It is the seat of learning for the Northern States. Harvard University was founded by John Harvard of Emmanuel College, Cambridge, as early as 1638, and the suburb of Boston which has grown up around it takes the

fitting name of *Cambridge*. *Lowell* and *Worcester* are important manufacturing centres in the state. The former is the centre of *textile* industries, cotton and wool. Worcester supplies the *machinery*.

The peninsula of Cape Cod shelters the bay of *Plymouth*, where the Pilgrim Fathers landed.

The large, mountainous, forest-clad State of MAINE was originally accounted part of the territory of the colony of Massachusetts. As yet it is the least developed of the Northern States. *Timber* is plentiful and yields pulp for the paper mills, which supply the paper for New York. The rivers supply excellent water power. *Bangor* has, as its name implies, a *slate* industry among these Primary rocks. *Augusta*, on the Kennebec, is the slate capital, but of relatively little importance. *Portland*, the principal harbour, is always ice free, and has made great strides as the winter outlet for Montreal, to which it is joined by the Grand Trunk Railway.

NEW HAMPSHIRE and VERMONT are hilly states divided by the *Connecticut river*. The Appalachian range takes the name of the *White Mountains* (6300 ft.), in New Hampshire and the parallel range in Vermont is called *Green Mountains* (Ver-mont).

Over the Green Mountains from the Connecticut valley is the even more important depression, which, in the north is drained by the *River Champlain*, through the ribbon-like lake of the same name to the St. Lawrence, and in the south by the *Hudson river*, at whose embayment stands New York. Vermont, however, does not share the Hudson river, which is entirely confined to New York State. *Concord*, in New Hampshire, is sufficiently near the Merrimac to join in the *textile* industries. *Burlington*, in the Champlain depression, diverts the *timber* of Vermont to the St. Lawrence.

Along the seaboard, south of Massachusetts, occur two small but busy states—CONNECTICUT and RHODE ISLAND. The geological formation is principally *New Red Sandstone*, as in

our vales of Trent, Weaver and Severn. The seaboard is fertile. *Building stone* is plentiful. Manufactures have led to the growth of *Newhaven*, *Waterbury* and *Hartford* in the larger state, and *Providence* and *Fall River* in the small but early-founded Rhode Island. Newhaven and Fall River have many *cotton* factories. Waterbury signifies cheap *watches* and *clocks*. Providence shares the *textile* industries. Newhaven and Providence stand on the main railway from Boston to New York.

The states of NEW YORK and PENNSYLVANIA have pushed back from the original bases of New Amsterdam and Philadelphia until they touch the lakes of the St. Lawrence.

The triangular state of New York has the *metropolis* of the Republic at its apex and the *St. Lawrence highway* as its base. Just within the eastern edge of the triangle, and parallel to it runs the *Hudson depression*, and running into this, at right angles, is the *valley of the Mohawk*, which at one period in geological history carried the drainage of the Great Lakes to the Hudson outlet. North of the Mohawk River rise the beautiful *Adirondacks*; to the south the *Catskill range*. The Hudson is navigable to *Albany*, and thence the *Erie Canal*, following the valley of the Mohawk, carries navigation to *Rochester*, on Lake Ontario. *Buffalo*, where Lake Erie overflows in the river Niagara, is the great river port of the State on the St. Lawrence system, and the focus of a dense population. The Erie Canal avoids the Niagara Falls and joins Buffalo to Rochester. It is *within easy access of Toronto*, the principal city of Ontario. *Troy* is the twin-town of Albany. *Saratoga*, of historic importance (1777) stands higher up the Hudson.

New York City, and its suburbs of *Brooklyn*, *Jersey City*, *Newark* and *Staten Island*, baffles description and needs none. It has a magnificent position at the meeting of river, sound and sea. From a Dutch settlement (1664) it has grown to a city of nearly five million inhabitants.

The oblong state of PENNSYLVANIA, arising from the original settlement of William Penn at Philadelphia, near the head of the Delaware estuary, in Charles the Second's reign, extends across the Alleghanies from the river (at its eastern frontier) to touch Lake Erie on the west. The lake-port of the same name stands at the opposite end of the diagonal from Philadelphia. Both the Delaware and the Susquehanna (which drains across the state from north to south) are characterised by the *zigzag courses* mentioned in Section III. of Canada. The latter river drains forward to *Chesapeake Bay*. Pennsylvania includes the richest portion of the *anthracite*, *coal* and *iron* areas; and it is as an outlet of these materials, as well as of the products of the resulting industries, that **Philadelphia** has prospered, and grown to a town as large as Glasgow and Liverpool combined. *Textile* industries help to find employment; *wool* is obtained from the sheep-farms amid the Alleghanies.

Anthracite is plentiful in the valleys of the Schuylkill and the Susquehanna.

The twin cities of *Pittsburg* and *Alleghany*, on the Ohio plateau, and at a confluence of rivers (Alleghany and Monongahela) are the centres of the *steel* industry and its accompanying manufactures. A *canal* connects them with the lake-port of *Erie*, whence oil is exported and iron-ore imported. It is around Pittsburg, in the hill-region, that *natural gas* is most plentiful. The direct line from *New York to Chicago* calls at Philadelphia and Pittsburg.

Pennsylvania has practically no seaboard; the lower reaches of the Delaware estuary have the small state of NEW JERSEY on the north and the smaller strip of DELAWARE State on the south. Off the coast of New Jersey stands the island-town of *Atlantic City*. Delaware State has its industrial focus and outlet port in the *shipbuilding-centre* of *Wilmington*.

Occupying both banks of Chesapeake Bay, and extending

to the *Potomac*, which forms its frontier from mouth to source, is the irregular and straggling state of MARYLAND.

Baltimore is nearly as large as Manchester and the gateway of the State. *Annapolis* shares with Baltimore in the export of the oysters from the famous beds of Chesapeake Bay. It is the State capital.

Harper's Ferry, on the Potomac in W. Virginia, recalls the futile efforts of John Brown (1859), whose "soul goes marching on."

The small independent district of COLUMBIA contains *Washington*, the seat of government.

(*b*) The Cotton and Tobacco States of the South.

South of the Ohio and the Potomac, the Alleghany ridges are prolonged in the *Blue Ridge*, the *Smoky Range* and the *Lookout Mountains*. To the west and interior, the Alleghany plateau is continued south in the *Cumberland plateau*, the facies changing from sandstone to limestone, with disappearance of oil and a diminution of coal. *Iron* of excellent quality, accompanied by *coal*, occurs in considerable quantity at the southern terminus of ridges and plateau. The Blue Ridge runs parallel to the Atlantic coast, south of the low, sandy *Cape Hatteras*, and leaves room for a *coastal plain, quite 200 miles in width*, which sweeps round the southern base of the uplands as far as the Mississippi delta.

Jutting out from it, but different in geological character in having much coral-reef, is the low, lake-covered peninsula of FLORIDA. Swamps are prevalent along the shore-lines of these southern states.

The coastal plain and its overlooking ridges are occupied by the states of VIRGINIA, the two CAROLINAS, GEORGIA and ALABAMA.

West Virginia, Kentucky and Tennessee occupy the Cumberland plateau, and will be considered in the section on the Mississippi and its feeders.

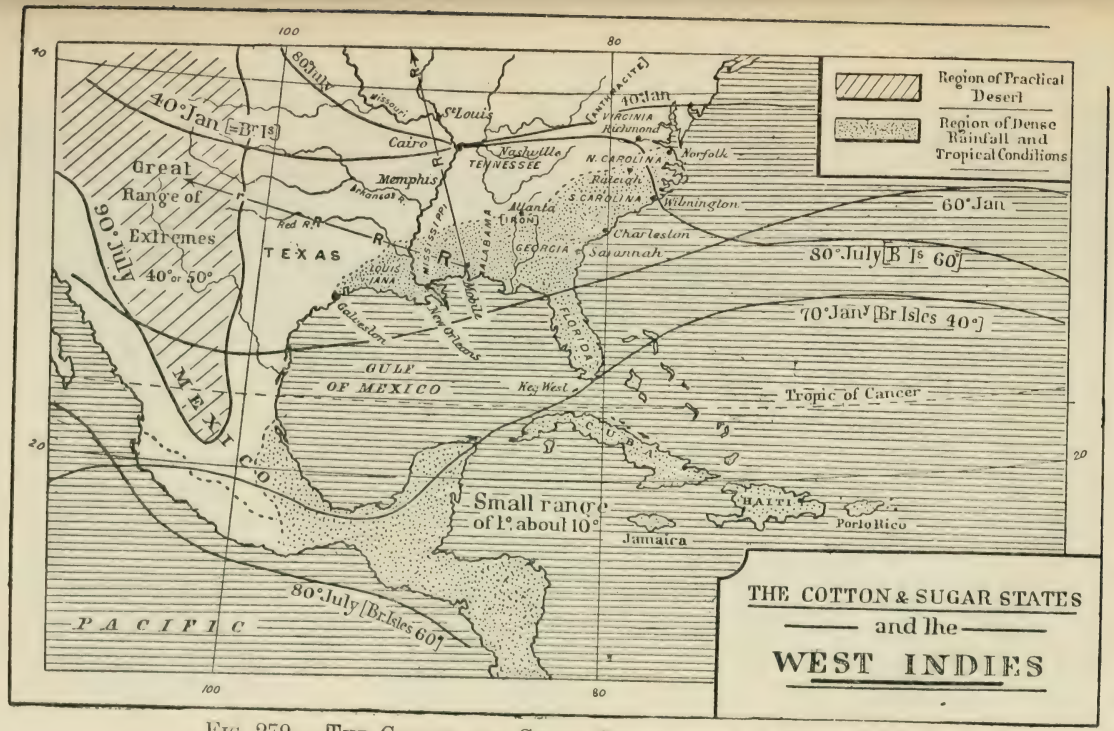


FIG. 279.—THE COTTON AND SUGAR STATES AND THE WEST INDIES.

The coastal plain is covered with loose gravelly and sandy deposits of *Tertiary* age. The soil is light and very productive.

Rainfall is considerable, attaining the high average of 60 ins. annually in the culminating region of the southern ridges (*Black Mountains*, 6700 ft.). This high rainfall is accompanied by summer and winter temperatures equal to those of Gibraltar or Egypt.

Such climatic conditions, coupled with a fertile soil, favour the production of *cotton* and *tobacco*. Cotton is cultivated on the *coastal-plain*; tobacco on the valley slopes and the *south-sloping plateau*. It was to these states that *negro slaves* were imported from West Africa. White people are far out-numbered by black, even to this day; they include the planters, overseers and factors; the working population are descended from the negro slaves.

VIRGINIA is essentially a tobacco-growing state; the valleys of the *James River* and the *Roanoke* (only partly in the State) are especially famed for their yield. *Richmond*, the principal town of the State, is the headquarters of the industry.

The three Cotton States of the Atlantic coastal plain have their outlets in *Wilmington*, *Charleston* and *Savannah*. The lower valley of the Roanoke is in NORTH CAROLINA. *Raleigh* is a small tobacco-growing centre in the north of the State. At *Wilmington* the cotton-growing district becomes important.

Oil is exported from here, the oil being derived from *cotton-seed*. *Turpentine*, a product of the yellow pine, is an important oil-export.

Charleston is the principal cotton-port on the seaboard of the Atlantic and the focus of industry of SOUTH CAROLINA.

Savannah comes a good second, and serves as the port of GEORGIA. From Cape Hatteras to Florida the coast is fringed with low, sandy islands, which yield the best quality of cotton. In the market, this goes by the appropriate name of "*sea-island cotton*."

Rice and *sugar*, as well as cotton (the student will have noticed how often these crops are associated), are profitably grown. *Fruit* and *vegetable* farms pay, the produce finding ready markets in the great cities of the North Atlantic States.

FLORIDA, originally Spanish territory, and sold to the States in 1821, occupies the coral-belt peninsula which ends in *Cape Sable*, together with a strip of the *Gulf coastal plain* as far as *Pensacola*. The peninsula derives less importance from cotton than from the numerous sub-tropical *fruits* (and especially oranges), which it supplies to northern markets.

St. Augustine, the oldest town in the Republic, is the Atlantic outlet. *Key West*, an island off Cape Sable, is a *naval station*, and commands the Florida passage to and from the Gulf.

ALABAMA remains the only state to be considered in this section. Its streams drain in parallel valleys from the terminating valleys of the Appalachian folds to separate outlets on the Gulf of Mexico. The principal river gives its name to the State. Whilst the coastal plain—hot, damp and fertile—shares in the *cotton* and *rice* production of these southern states, the ridges and valleys in the north of Alabama yield excellent *iron*, and some *coal*. The ambitious name of *Birmingham* has been given to the iron centre.

Mobile is the port of the State and stands at the mouth of the Alabama River. Next to New Orleans, it is the principal outlet on the Gulf of Mexico for *cotton*.

The main railway line from *New York to New Orleans* follows the foot of the Appalachian ridge, but gives off a branch at *Charlotte* in North Carolina, to link up the ports of the Atlantic coast. *Atlanta*, the capital of Georgia, is the most important station on the line south of Washington.

II.—The Basin of the Mississippi.

APPROXIMATE CO-ORDINATES OF—

CHICAGO: $87\frac{1}{2}°$W., 42°N. ST. LOUIS: 90°W., 38°N.

NEW ORLEANS: 90°W., 30°N.

THE Continental Interior of North America is a wide, shallow depression, extending from the Arctic Seas to the Gulf of Mexico. Almost coinciding with the political boundary which marks off the *northern* section as belonging to Canada, and the *southern* half as part of the United States, runs a faint *divide*, built of glacial débris and forming a gentle upswelling of the contours, which throws off streams to the north-east towards the Hudson depression and St. Lawrence trough, and on its southern side gives rise to the Mississippi. This "Mother of rivers," for that is the meaning of its name, persists in a southerly course, roughly parallel to the mountain wall of the Rockies on the western boundary, and to the symmetrically-folded ranges of the Alleghanies on the eastern side, though considerably nearer the latter.

This leaves room for the development of larger tributaries on the west than on the east. The *Missouri* is a far mightier stream than the *Mississippi* itself when they join at St. Louis, and can boast, in the *Yellowstone* and *Platte* rivers, streams as long as the Ohio and its affluents. The *Arkansas* and *Red* rivers are tributaries from the Rockies and enter the Mississippi below St. Louis. From the Alleghanies come the *Ohio* and its feeders, the *Cumberland* and *Tennessee*.

Extending from the mountain ranges on both west and east toward the mid-stream of the basin are *plateaux* which

practically coalesce in the north, above St. Louis, but leave room for a long, *bay-like northward projection of the coastal plain* up the river as far as St. Louis, and along the Ohio as far as Cincinnati. The *Alleghany* plateau and its southern continuation, the *Cumberland* plateau, receive more rain than the tablelands at the foot of the Rocky mountain-axis. The rocks are, however, harder, being geologically much older and more consolidated. Earth sculpture has therefore given valleys of cañon-type, such as we expect to find in less rainy regions. This is especially true on the Cumberland plateau of ancient limestone formation. The valley of the *Kanawha* is most striking in this respect.

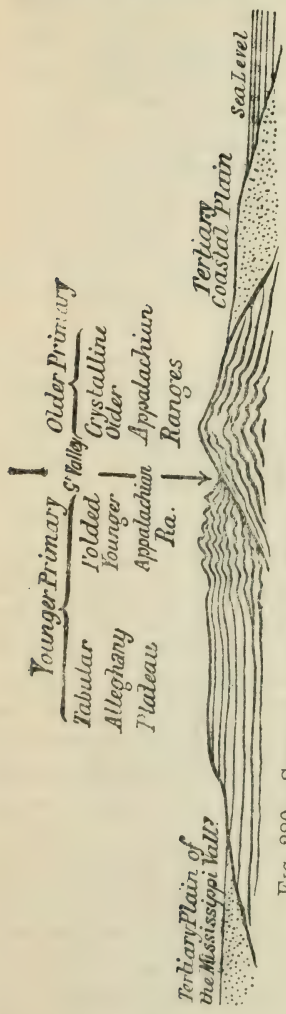


FIG. 280.—SECTION FROM THE MISSISSIPPI EASTWARD TO THE ATLANTIC.

The student will have learnt from Chapter II., Fig. 247, that the Rocky Mountains are flanked on the long eastern wall by nearly horizontal beds of Secondary and Tertiary strata. The materials of these beds are much softer and therefore more susceptible to denudation than the older rocks of the Alleghanies. Rainfall is here low and so conditions are more favourable to valleys of the cañon-type. The valleys of the

streams from the Rocky Mountains are cut deeply into the flanking plateau, and so divide the once continuous table-land into blocks of country bounded by valleys. These blocks are *steppe-like* in character (owing to low rainfall), and retain in many parts the original Spanish name of *llanos*.

The triangle of plateau between the Missouri and the Ohio is covered with *glacial débris* and the *floor-deposits* of many glacial lakes. It is remarkable how closely the two streams mark the southern limit of glaciation within the Continental Interior. This is the real region of *prairie*, convertible to productive *corn-land*—growing wheat, maize, millet—when put under the plough.

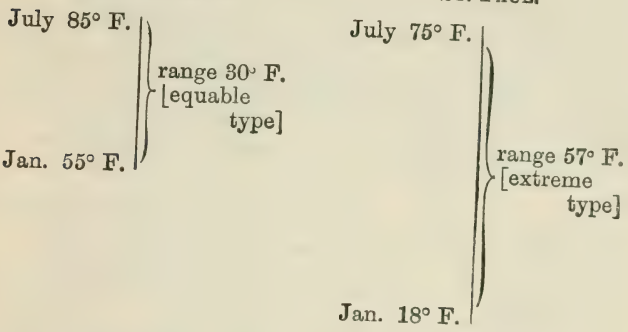
The low-lying coastal plain encircling the Gulf, and extending along the Atlantic seaboard as far north as Chesapeake Bay, also penetrates the Mississippi valley to a similar north latitude. Given rain and warmth, this fertile *Tertiary plain* is everywhere adapted to the cultivation of *cotton*. *Rice* and *sugar* accompany cotton on the shore-lands. *Tobacco* thrives in the valleys which open out on the plain.

The Kansas and Arkansas tributaries, rising in the vicinity of *Pike's Peak*, where the Rockies culminate at over 14,000 ft., separate widely before joining the main streams. Between them rises the *Ozark uplift*, a low dome of ancient rocks from which the overlying younger beds have been denuded (as in our Mendips). The Missouri and the Mississippi follow the northern edge of this uplift (called the Ozark Hills) from Kansas City to Memphis. Along this northern edge lie nearly horizontal *coal measures*.

Temperature is remarkably uniform and high all over the basin in summer; the July Isotherm, 75° F., follows closely the boundaries of the drainage area. Thus, *summers* are exceptionally hot on the corn-lands around St. Paul, on the Upper Mississippi—a fact which favours wheat-growing.

In *winter*, however, temperature belts run almost parallel

to latitude-zones, and St. Paul is consideraly colder than New Orleans.



The greater *range* of the northern city corresponds to a drier climate and a continental interior.

Rainfall diminishes steadily as we ascend the Mississippi-Missouri from mouth to source. Again, travelling across the continent by any of the main traffic lines, it falls quickly from east to west. The delta is the wettest area in the basin. The *llanos* are the driest and their *steppe-lands* are best suited for ranching. The "blue-grass" states of the Cumberland plateau have *tobacco* plantations. The Ohio valley is the principal region of *manufacturing* and *mining* industries in the basin; *oil*, *coal* and *iron* are plentiful; *copper* and *nickel*, as well as *timber*, are easy of access from Canada.

The Ohio valley and the course of the main river are naturally the lines of densest population. To these should be added the *lake-frontier*, which affords outlet, *viâ* the St. Lawrence, as well as intercourse with the busiest province of Canada, for the fertile prairies and the resources of the Ohio-Alleghany plateau. It is on river or lake-margin that we must look for the great cities of the Continental Interior.

Traffic, however, tends more and more to ignore the old *navigation-lines* and to strike *transversely* across the basin from the old, highly-developed ports of the Atlantic to the fewer and newer developing gates of the West.

The **Ohio-Cumberland plateau** includes portions of the States of New York and Pennsylvania (already considered on *pp.* 520 and 521, together with the States of OHIO and INDIANA on the *north*, each with a frontier on river and lake, and the States of WEST VIRGINIA, KENTUCKY and TENNESSEE on the *south*.

(*a*) The *two northern states* share the *oil* and *coal* industries of the plateau. *Maize* and *wheat* are plentifully grown.

Cleveland and *Toledo* are the lake-ports of OHIO on Lake Erie. *Columbus*, in the centre of the State, is the railway focus. *Cincinnati*, on the river, is the most important city, as large as Bristol, engaged in the meat, wheat, coal and tobacco industries.

INDIANA is more remote from the coal and iron industries and more engaged in the *corn* and *meat* trades. Coal does occur, however.

Indianopolis is the capital and the railway centre. *Chicago*, just outside the frontier, on Lake Michigan and *Louisville*, just across the river on the Kentucky side, have hindered the development of lake and river ports in this agricultural state.

(*b*) South of the *Ohio* river, the plateau is deeply intersected by the three rivers, *Kanawha*, *Cumberland* and *Tennessee*. WEST VIRGINIA and KENTUCKY occupy the plateau between the Alleghany Mountains and the river, which is their northern boundary. TENNESSEE is an artificial slice of country extending from the *Smoky Mountains* to include a portion of the flood-plain bordering the left bank of the Mississippi. The plateau is famed for its "*blue grass*," limestone caves (the *Mammoth Cave* of Kentucky is the largest in the world) and *tobacco* plantations. *Coal* and *iron* occur,

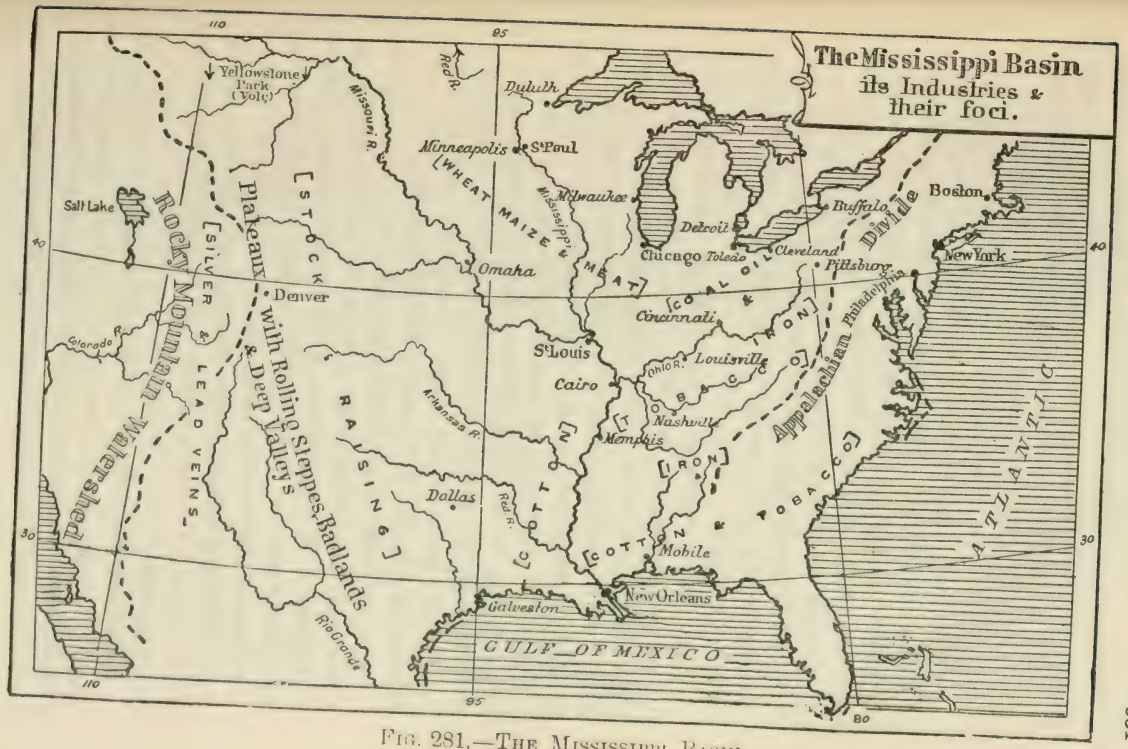


FIG. 281.—THE MISSISSIPPI BASIN.

as also excellent *timber*. WEST VIRGINIA has no towns of importance. *Charleston*, in the cañon-like valley of the Kanawha, is the chief. KENTUCKY has its capital and busiest city in *Louisville* on the navigable Ohio. Tobacco is the staple industry. Only the middle courses of the Cumberland and Tennessee rivers (which rise in different states, but join the Ohio at points in close proximity in the State of Kentucky) fall within the State of TENNESSEE. *Nashville* on the one and *Knoxville* on the other stream are the principal cities on the plateau. The former is a tobacco-manufacturing centre. *Memphis*, a busy river-port on the Mississippi, is the focus of trade for the lowland half of the State. *Cotton* can be grown in this area.

What may be grouped as the **"Food States,"** occur on the low plateau between the Missouri and the Great Lakes. West of the Missouri are the foot-hills of the Rockies, which determine largely the course of the Missouri. The Upper Mississippi and its many affluents drain this low plateau on the *south* side of the faintly-marked "divide," and the *Red River*, finding its way to Lake Winnipeg (in Canada), on the *north* side of the watershed. Mention has been made of the mixed soil produced by glacial deposition and by lake-sediments, and of the fertility resulting from it.

The food states have the great advantage of navigable rivers and lake-outlets and it is in connection with these facilities that we must look for the industrial centres. *Wheat* and *maize* are the prime cereals, though *rye* and *oats* are considerably grown. The maize is largely used for the fattening of hogs, and so leads to the *meat industries* associated with these states. The *hot summers* are especially favourable to wheat-growing.

ILLINOIS, with frontiers on the Mississippi, the Ohio and Lake Michigan, is the busiest of the food states. On its western boundary are the important confluences of *Mississippi-Missouri* and *Mississippi-Ohio*, with the very important river-

ports of *St. Louis* and *Cairo*, now not depending so much on the river as in the days before the trans-continental railways. St. Louis is, however, across the river, in the State of Missouri.

Chicago is the metropolis of the food states, and the largest city in the Continental Interior. It stands second to New York in rank of population among American cities. With the *wheat-lands* to the north-west and the *maize-fields* to the south-east, it has great trade in wheat and meat. A complete network of trunk lines converges on the city, which has a fine position at the head of Lake Michigan. *Milwaukee* serves a similar office for WISCONSIN, another state with the advantage of lake-frontier. *Mineral wealth* (coal, iron, galena, copper) is abundant in these lake-bordering states. *Madison City* and *Green Bay* are foci of industry and population.

The northerly state of MINNESOTA, drained by the head-waters of the Mississippi, has a capital outlet for its produce in *Duluth*, the head of navigation on Lake Superior. Winnipeg, over the Canadian boundary, is near at hand. The "Mother of rivers" is navigable as far as the twin cities of *St. Paul* and *Minneapolis*—both within the State—rivals in food production. Navigation ends with *St. Anthony's Falls*, which, however, afford water-power for corn mills.

The *Red River*, whose prairies are perhaps the most fertile among the lands of the food states, divides Minnesota from the two States of NORTH and SOUTH DAKOTA. The *Upper Missouri* dissects these states, and, moreover, divides them into natural regions. Towards the Red River the *prairies* share in the wheat industry. West of the Missouri the ground rises, and tilled land gives place to *steppe-country*, given over to stock rearing.

NEBRASKA and IOWA, states on opposite banks of the Missouri, show similar characteristics to the Dakotas and Minnesota respectively.

Omaha is a busy river and railway centre on the Nebraska side and at the confluence of the Missouri and Platte Rivers.

It has considerable coal resources in its vicinity. *Des Moines* is the topographical and commercial centre of IOWA.

KANSAS resembles NORTH and SOUTH DAKOTA and NEBRASKA in being *steppe-country* to the west and cultivated *prairie-land* towards the Missouri, on which river it has a few miles of frontier and a port in *Kansas City*.

MISSOURI may be considered the transition-state from the "food states" of the northern plateau to the "cotton states" of the Tertiary plain.

It owes much to the mighty rivers which mingle their waters on its eastern frontier, and it is along these rivers that the cities of the State have arisen.

St. Louis, the most important river-port in the United States, stands easily first. It forms the meeting-place for wheat, tobacco and cotton growers. *Jefferson City* stands in the middle of the State, on the Missouri.

The lake-bordered State of MICHIGAN should be considered with this northern group. It has frontiers on *four* of the Great Lakes and easy access to the busiest area of Canada. It is an area of Primary rocks and is exceptionally rich in *mineral resources*. *Copper* and *galena* in the older rocks and *coal* and *iron* in the newer Primaries give rise to many industries, and the consequent aggregation of population.

Detroit is the foremost of Michigan cities, a focus of American and Canadian railways, a centre of smelting industries, being nearest the St. Lawrence highway. *Bay City*, on the Saginaw arm of Lake Huron, is growing in importance as an ore-smelting centre.

From St. Louis to New Orleans the Mississippi flows over low-lying Tertiary lands, with the *Cumberland uplift* on the east and the *Ozark uplift* on the west. These Tertiary lowlands extend back along the river like a *bay* of the coastal plain. The river brings down much fine silt, and in its sluggish course across the lowlands deposits its load on the

flood-plain. To prevent unregulated floods, the river has been banked in the same way as the *Po* at Ferrara and the *Rhine* in Holland; now, by depositing sediment in its own channel, the bed of the river has been raised higher than the level of the surrounding country. Only by means of strong *dykes* can disastrous floods be prevented.

Oklahoma, Indian Territory and Arkansas, drained by the *Arkansas River* on the south of the *Ozark anticline*, have no towns of first importance. The lava-sheets of the *Washita valley* supply excellent grindstones. Indian Territory was set apart for occupation by the descendants of Red Indian tribes. It is now amalgamated with the State of Oklahoma (1906).

Little Rock, the capital of Arkansas, is a small town of not more than 30,000 inhabitants. It stands on the railway which skirts the western (*Ozark*) edge of the plain from the Ohio confluence to the Mexican tableland. *Helena* is a river-outlet.

The **"Cotton States"** of the Mississippi proper are Mississippi and Louisiana, on opposite banks of the river. The outlets for the cotton are *Mobile* (just over the frontier of Mississippi, in Alabama, and on the open gulf) and *New Orleans*, at the head of the *digitate delta* of the Mississippi, the principal city of Louisiana and the great gateway of the interior.

The cultivation of *sugar* and *rice* on the Gulf plain gives additional industries to these ports. The plantations are, moreover, extending along the unhealthy coastal plain as far as *Galveston* in Texas. This port is built on an island commanding a spacious harbour, and serves as an outlet for the *cotton*, *sugar* and *rice* of the plain, as well as the *cattle* and *horses* for export from the steppe-country behind the coastlands.

Louisiana was the name given to the whole plain west of the Mississippi by the French, when they entered from the south by way of the river, and took possession in the name

of Louis the Fourteenth, in 1700. New Orleans was the first settlement. The whole territory was purchased from Napoleon in 1803.

The lofty Rocky mountain-wall forms the western watershed of the Continental Interior. It runs, like a backbone, through the middle of the States of MONTANA, WYOMING, COLORADO and NEW MEXICO. East of the mountain-wall are the tablelands and *foot-hills*, built of soft *Secondary* and *Tertiary* sediments. These tablelands have been deeply scored by the streams which cross them from west to east to join the Missouri-Mississippi system. They are *steppe-like* in character, owing to diminished rainfall. *Stock rearing* —cattle and horses, rather than sheep—finds occupation for the farmers of these states. TEXAS, the largest state of the Union, ceded by Mexico in 1836, is almost entirely steppe-country; the Rocky Mountains form its western wall, and the Tertiary plain its coastal fringe.

The Rocky Mountain Axis is rich in the precious **Metals**—*gold*, and especially *silver*. Silver is, as usual, accompanied by *lead-ores*. The states of this section may therefore be grouped as the **"Mining States."**

Butte is a mining centre near the source of the Missouri. The *Yellowstone River* rises in an area of decaying vulcanicity (as indicated by the presence of *geysers*) just within the north-western angle of the State of Wyoming. The region has been reserved as a *National Park*. A pushful Chinaman from San Francisco had proposed to establish a laundry at the Hot Springs.

Denver, *Pueblo* and *Leadville* are important centres in the Colorado mining district. *Denver* is a tourist centre for the fine scenery of the Rockies around *Pike's Peak* (14,140 ft.), *Long's Peak* (14,270 ft.) and the source of the *Colorado River*. *Leadville* is an important silver-mining centre. *Santa Fé* is

the principal town, as well as the industrial and railway centre of New Mexico.

At the foot of the Rocky Mountains in Texas is the solitary barren tableland known as the *Llano Estacado* (the staked plain). East of this tableland, as the rainfall increases, semi-desert conditions give way to grass-lands, on which many *horses* are reared.

Dallas is the market centre. It has railway communication with *Galveston* on the Gulf of Mexico. The *Rio Grande del Norte* forms a convenient frontier, fixed by the United States when Texas joined the Union.

III.—The Rocky Cordillera and the Pacific Seaboard.

Approximate Co-ordinates of San Francisco: $\frac{122\frac{1}{2}^\circ \text{ W.}}{37\frac{1}{2}^\circ \text{ N.}}$

The mountain-system of the *Western States of the Union* differs in many respects from that of its northern counterpart in *British Columbia*. There a series of parallel ranges of descending altitude fill the country between the culminating *Rockies* and *Selkirks*, and the off-lying, partially-submerged chain of islands. In the United States, however, the Cordillera widens out into a *lozenge-shaped mid-region of plateau*, with the lofty range of the Rocky Mountains on the east, and the parallel-ranges of *Sierra Nevada* and the *Coast Range* on the western seaboard. This tabular country is practically unrepresented in British Columbia and the type of country it affords is nowhere else found in the North American Continent. In physical structure and in climatic conditions it stands unique.

The *Rocky Mountains*, previously described, with their *mining* and *tourist* centres, are equally well represented in the giant Selkirks of Canada. Mount Brown and Mount

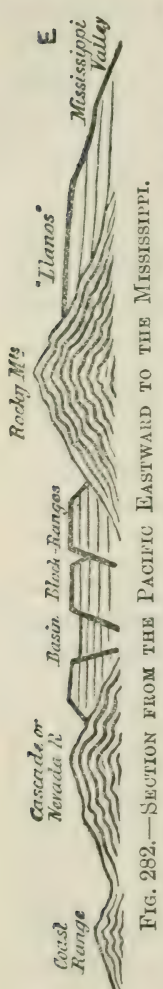


FIG. 282.—SECTION FROM THE PACIFIC EASTWARD TO THE MISSISSIPPI.

Hooker compare with Pike's Peak and Long's Peak in the States. The silver of the States is replaced by copper in the Dominion. The genial climate of British Columbia is shared by the fruitful land of California. The sheltered valleys between the Sierra Nevada and the Coast Range are famed for their *fruit*; the mountain slopes yield abundant *timber* from trees unequalled for size in any other part of the continent. The seaboard is extremely fertile; rainfall is abundant; temperature is, on the average, *10° F. higher* than in British Columbia, since California is further south.

The *contrast of geographical conditions* on the two sides of the Sierra Nevada is as striking as any to be found, either in the Old World or the New. From coastlands and valleys of amazing fertility and magnificent forest scenery, we come upon the barren, mountain-walled plateaux which fill the broad belt between that range and the Rocky Mountains.

Rainfall suddenly *diminishes to one-fourth* of the precipitation on the coastal belt; the southern section of the plateau, across which the *Colorado River* finds its way to the long inter-mont drowned-valley known as the Gulf of California, is considerably drier than the colder northern section, and is practically desert. The *Colorado plateau* in summer is as hot as the Sahara.

Salt-basins occur here, as in nearly all arid districts, that of the *Great Salt Lake* being the most famous. It is cut off from

the Colorado plateau by the *Wasatch range*. *Death Valley* is another salt-basin, in which the lakes are well nigh evaporated to dryness.

The whole plateau is *divided into basins* by low ranges, like the Wasatch Mountains. The structure of the country is probably that illustrated in Fig. 282.

Two of the plateaux deserve special notice. The *Colorado plateau*, drained by the river of the same name, is a tabular block of country into which the river and its tributaries have cut deep cañons, which are the wonder of the world. In many places they are 4000 ft. deep, and on their sides are exposed the *whole geological series* of strata from the fundamental *crystalline* rocks, right up to the youngest *Tertiary* sediments. The shape of the section of the cañon suggests diminishing rainfall, for as the cañon has grown deeper, the widening, due to rain-denudation, has not kept pace. (*See* Fig. 283.) The streams are fed by the rains of the Rocky Mountain summits, amidst which they take their rise. Just as the Nile rises in a region of heavy rainfall and then crosses the rainless desert of Libya, so the Colorado cuts its cañons through a practically rainless desert-tableland.

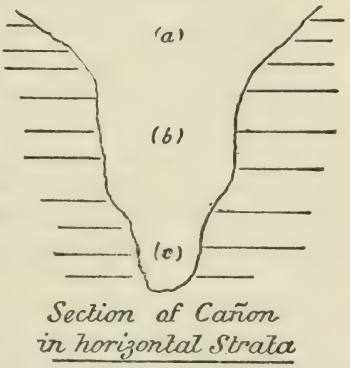


Fig. 283.—Section of Cañon in Horizontal Strata.

The *Snake River* also cuts a magnificent cañon as it makes its way across the *basalt plateau* which fills the northern angle of the Cordillera between the Cascade Range (a continuation of the Sierra Nevada) and the Rocky Mountains. The lava-flows, piled one upon another, that have built up

this *Columbia plateau* have an aggregate thickness of nearly a mile, and they cover an area of 250,000 square miles.

The united waters of the Columbia and Snake Rivers find their way to the sea through a *gap* in the Cascade range, just at the foot of the lofty extinct volcano of *Mount Hood*. Other prominent volcanic peaks along this inner range are *Mount Shasta* (14,370 ft.) and *Mount Whitney* (14,900 ft.). The longitudinal valleys between the coast-range and the loftier watershed formed by the *Sierra Nevada* find transverse outlets in gaps in the coast range. The combined waters of the *Sacramento* from the north and the *Joaquin* from the south thus escape into San Francisco harbour.

California, like British Columbia, first attracted settlers by its *mineral wealth*, and more especially *gold*, in the slaty rocks of the Sierra Nevada. Afterwards followed the farmer, who saw in the fertile valleys and genial climate possibilities of *fruit-culture* unrivalled elsewhere in the States. The abundant *timber* attracted lumberers from the eastern states. Some *grain* is grown in the valleys.

Washington, Oregon and Idaho are drained by the Columbia and Snake Rivers, which empty into the Pacific below *Portland*. A longitudinal valley extends to the south from Portland. In it stands *Salem*. This valley opens northward to *Puget Sound*, an arm of the Vancouver Channel. *Seattle* is a port of rapid growth on the Puget Sound. *Tacoma* is growing up quite near. *Spokane* is an agricultural and railway centre on the Columbia plateau.

Timber and *salmon* are the chief exports from the Columbia region. The salmon abounds in the *Columbia River*. Salmon tinning is the principal occupation of the people of *Astoria*, at the mouth of the river. *Portland* links trans-continental railways with trans-Pacific steamers.

California skirts the Pacific seaboard through 10° of latitude. It extends from the shore back to the summits

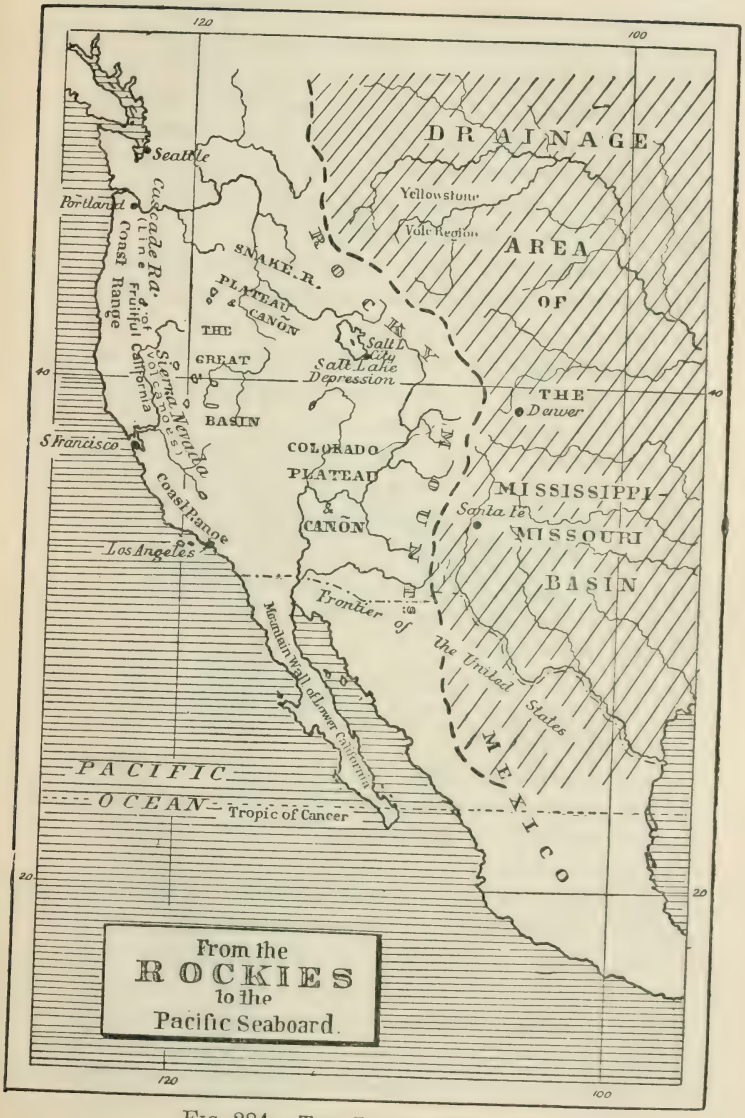


Fig. 284.—The Pacific States.

of the snow-clad *Sierra Nevada* (nevada=snowy). It consists therefore of coastlands, coast-range, inter-mont valley and culminating ridge, all parallel to the trend of the coast-line. *Mount Shasta* stands like a lonely sentinel on the northern frontier; the southern boundary touches the *Colorado River*. The mountains are famous for their big trees (*e.g.*, Douglas fir), and the valleys and the coastal plain for their fruit, *pears* and *grapes* being especially profitable.

Sacramento City is the industrial centre of the valley. Between it and San Francisco is aggregated the bulk of the population.

San Francisco has more than local importance. It is not merely the outlet for the wheat, fruit and timber of the Sacramento valley. It forms the *western terminus* of the most important of the trans-continental lines—the Central Pacific Railroad—and has long been the principal port on the American Pacific. Unlike Vancouver, it has *no coalfield* at hand. The coast-range, on which the town is built just at a sea-filled gap, is liable to earthquake shocks. *Oakland*, across the harbour, is the residential suburb. The old town has a Chinese quarter.

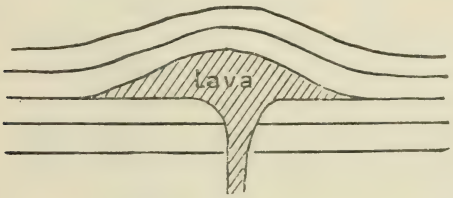
(The world-famed *Yosemite Valley* and the region of "big trees of *Mariposa*" occur in the Sierra Nevada, to the south-east of Sacramento.)

Los Angeles is a busy port serving the southern section of the State. It is well placed in relation to the *southern trunk lines* from the "cotton states" of the south-east.

The states of the Cordilleran plateau are NEVADA, UTAH and ARIZONA. The average elevation is quite 6,000 ft. Temperature is so high and rainfall so low that the whole region is *arid semi-desert, with salt-basins* in the two northern states and *barren waste* in Arizona. The *Central Pacific Railway* strikes across Utah and Nevada from Omaha (on the Missouri) to San Francisco. It skirts the northern shore of the Great

Salt Lake, once a fresh-water lake, draining to the *Shoshone River*. The lake stands more than four thousand feet above sea level.

Salt Lake City has gained notoriety from its community of Mormons. To the east rise the *Uinta Mountains*, whose domes have been raised by the intrusion of lavas from below into the upper strata, which have become thereby arched into low elevations of characteristic form. Such hidden accumulations of lava are known as *laccolites* (stone-cisterns). Owing to low rainfall, the overlying sediments have not been denuded. It is believed that laccolites are common structures laid bare, and made therefore less obvious, in other regions where the rainfall is considerable.



Structure of a Laccolite

FIG. 285.—STRUCTURE OF A LACCOLITE.

ARIZONA is the hottest and most barren of American states. The famous cañons of the Colorado—the *Marble* Cañon and the *Grand* Cañon—are both within this state. The railway from Santa Fé to Los Angeles crosses the plateau to the south, at one point (*French Springs*) approaching to within 40 miles of the Grand Cañon. The lowlands around the lower Colorado are more fertile.

ALASKA, an Arctic territory purchased from Russia in 1867, should be mentioned in this section, since it represents the *northern limits* of the *Rocky Mountain ranges* and the

Pacific Seaboard. It has an area at least four times that of the British Isles. The long Alaskan peninsula and its continuation in the *Aleutian Islands* is a chain of volcanoes continuous with those of the opposite Kamschatkan peninsula. The narrow and shallow *Bering Strait* divides the Old World from the New. A broad *submarine platform*, less than 100 fathoms below the surface, links what seem separated. *Seal* and *cod* fisheries are carried on. The broad valley of the *Yukon*, in whose upper basin *gold* is found, opens out upon the marshy shore-lands of the Bering Sea.

CENTRAL AMERICA AND THE WEST INDIES.

I.—The Central American States.

APPROXIMATE CO-ORDINATES OF MEXICO: 99° W. / 20° N.

SOUTH of the United States frontier and the Rio Grande del Norte, the widely separated marginal ranges of the Rocky Cordillera converge to give the V-shaped tableland of **Mexico**. The apex of the V occurs at the *Tehuantepec depression* in long. 95° W. and lat. 17° N. The plateau descends suddenly upon the narrow fringes of coastal plain.

Beyond the Isthmus of Tehuantepec, the folded-mountain-systems have a west-east trend, not north-south, like those of the two continental masses. These transverse ranges divide the ocean separating North America from South into *two distinct inland seas*—the *Gulf of Mexico*, mainly outside the Tropics and the *Caribbean Sea* entirely within. Both depressions are deep. The line of the **Greater and Lesser Antilles** is really therefore the curve of a partially submerged mountain range. Two axes can be distinguished. The outer and more dominant forms the backbone of *Cuba*, the main range of *Haiti* (on the north side) and the chain of islands from *Puerto Rico* to *Grenada*.

Trinidad is an outlier of the South American mainland.

The minor range strikes from *Honduras* by a submarine ridge to *Jamaica*, and is continued in the *southern* range of the island of Haiti. Everywhere these Central American

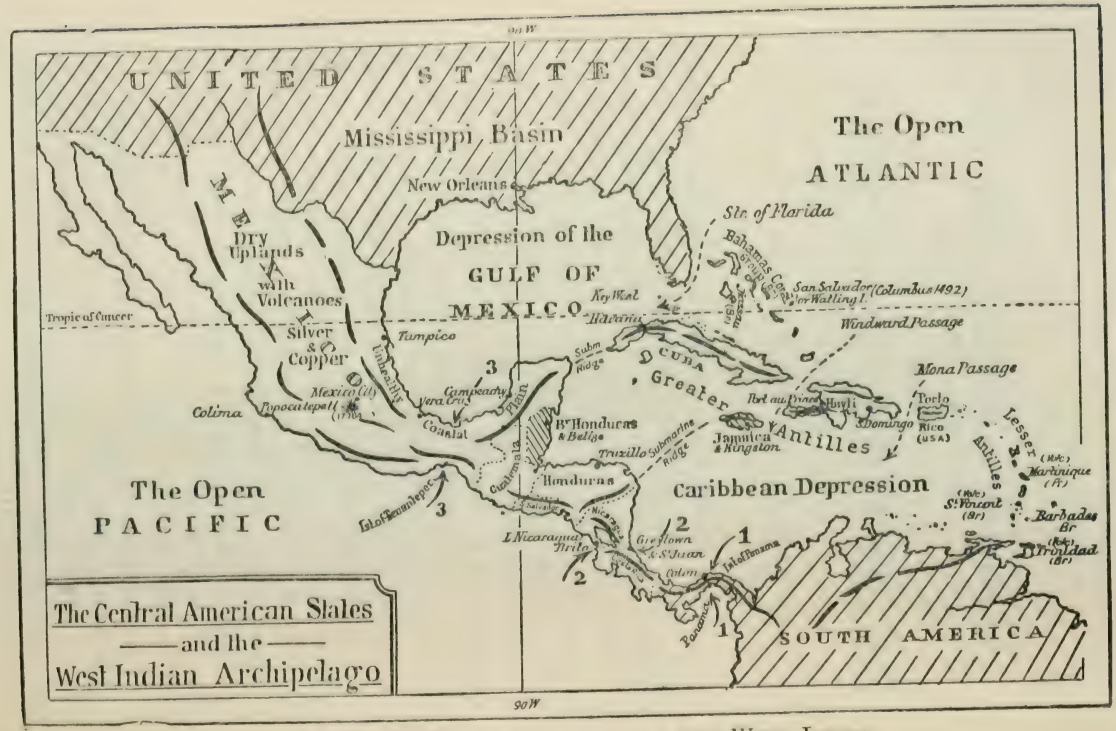


FIG. 286.—CENTRAL AMERICA AND THE WEST INDIES.

mountain axes are scattered with *volcanoes*, and more or less subject to *earthquakes*.

The off-lying **Bahamas** group belongs in character to Florida rather than to the West Indian Archipelago.

The linking chain which joins the Rockies of North America with the Andes of South America follows the Pacific seaboard, leaving little or no coastal plain. The isthmus formed by this system is narrowest at *Darien-Panama*, close to the southern continent.

Though some of the islands (*e.g.*, the *Bahamas*), and nearly the whole of the *tableland of Mexico* are outside lat. 23½° N., the whole region is practically tropical in character. The extra-tropical portion of the Mexican plateau is *hotter* in July than any island within the tropics. It resembles Texas rather

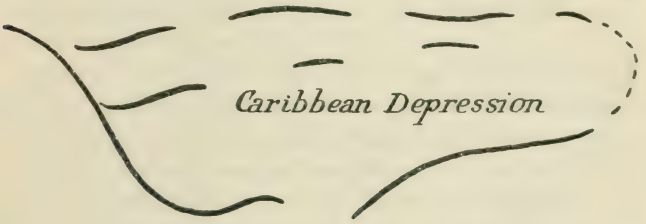


FIG. 287.—CARIBBEAN DEPRESSION

than Central America in character and is thinly peopled. The numerous cities of Mexico fall within the tropic of Cancer.

The **range** between summer and winter average temperatures is greatest on the tableland, reaching as much as 25° F. (90° F.-65° F.). But in the archipelago it sinks to less than 10° F. (80° F.-72° F.). The *mean annual temperature* is 30° F. hotter than the British Isles.

Rainfall is very considerable, exceeding *75 ins. annually* on the coastal plains fringing the two depressions, and is derived from winds blowing in *from the Atlantic* rather than from the Pacific, along whose coast rainfall is decidedly less. The Mexican plateau, shut in by mountain-barriers, and there-

fore a region of *rain-shadow*, has the lowest rainfall, and hence the maximum range mentioned above.

The rainy lowlands are extremely unhealthy, as in all tropical countries. The hill slopes and the tableland have a comparatively fine climate.

It is the unhealthy lowlands that are especially productive. *Cotton*, *sugar* and *rice* thrive on the plains; *tobacco*, *coffee* and *tropical fruits* (*e.g.*, the banana and the lime-fruit) on the slopes. *Spices* and *drugs* are grown on the islands and shore-lines. Forests of *mahogany*, *rosewood* and *ebony* clothe the hill-country.

The healthy tableland is less productive agriculturally. Grassy *steppes* are common. *Maize* can be successfully cultivated. In mineral wealth, however, the plateau is very rich, whilst the ranges of the archipelago are extremely poor. *Silver* is the most important, though gold, copper, lead and mercury occur.

The *gaps* in the chain of the Antilles allow access of vessels from the Atlantic to the Caribbean depression. The principal channels go by the names of *Windward Passage* and *Mona Passage*. *Florida Channel* admits to the Gulf of Mexico. As yet no way across the isthmus for ocean-going vessels is available. Projects for a canal on the scale of the Suez Canal have been put forward. The earliest was that of the proposed *Panama Canal*. M. Ferdinand de Lesseps failed here after succeeding at Suez. A *mountain-backbone* to cut through and a terribly heavy death-roll, owing to the *unhealthy climate*, postponed the scheme indefinitely. The United States Government has solved the problem. Rival schemes to that of the *Panama Canal* have been proposed, to follow the *Nicaraguan* and the *Tehuantepec* depressions respectively. The positions of the three routes are indicated on the map, Fig. 286 (note 1, 2, 3). The Tehuantepec route has the greatest advantage of climate. An English firm in 1908 completed a *railway* along the route from sea to sea.

The student should consult a globe, with a view to ascertaining how much the journey to Australia would be

shortened if any of these canals allowed the passage of ocean-going vessels.

Mexico is larger and more important than all the rest of the States on the Central American isthmus. The Spaniards sailed to the west, according to the papal bull of Alexander VI., and in 1519 settled on the Mexican part of the isthmus; Cortez completed the conquest in 1522. Here they found a highly civilised tribe, the **Aztecs**, living on the plateau.

Many *splendid ruins* of Aztec cities remain to this day. The Spaniards who had colonised the Greater Antilles had been attracted by the vast *mineral wealth* of the plateau. The mines had been worked for six or more centuries and much silver and gold had accumulated. This the *Spanish sailors* seized and brought home to Spain, then in the heyday of her prosperity.

Since the sixteenth century the country has had a chequered history. To-day it is a *republic* of fifteen million souls. The chief cities are on the healthy tableland; the ports are of necessity on the unhealthy coastal plain.

Mexico and *Puebla* are the most important upland towns. The former is the *capital* and about as large as Bradford. The latter is the industrial centre of the plateau; it exports *sulphur* from the neighbouring volcanoes of *Popocatapetl* and *Orizaba*, cones rising 11,000 ft. above the plateau, which itself attains a height of from six to eight thousand feet above the sea level.

San Luis Potosi is an important *silver*-mining centre; *Guanajuato* has *gold*-workings.

Mexico and Puebla find an outlet in *Vera Cruz*; Guanajuato and San Luis Potosi in the healthier port of *Tampico*.

Jalapa is the market-centre of the coastal fringe.

Mazatlan and *Acapulco*, much healthier than the Gulf ports, are calling-places for tramp-steamers on the Pacific seaboard.

The forest-clad plateau of **Yucatan**, much lower than the tableland of Mexico, belongs to the Republic.

Campeachy is the export town.

The remaining states of the isthmus are GUATEMALA, HONDURAS, NICARAGUA, SAN SALVADOR and COSTA RICA. They share the common characteristics of tropical mountainous lands, resembling the members of the archipelago rather than the broad tableland of Mexico. **Great Britain** holds a portion of HONDURAS, with *Belize* as its port.

II.—The West Indian Archipelago.

APPROXIMATE CO-ORDINATES OF—

HAVANA: $82\frac{1}{2}^\circ$ W., 23° N. KINGSTON: 77° W., 18° N.

THE **major islands** of the West Indian Archipelago are CUBA, HAITI, PUERTO RICO and JAMAICA.

The long, mountained-walled island of CUBA is especially famed for its *tobacco* plantations. *Havana* is the capital and principal port, since cultivation is chiefly in the west of the island. *Santiago* serves the eastern end of the island and stands close to the Windward Passage. *Coffee* is an important export.

The island has had an eventful history. Remaining under *Spanish* rule till the nineteenth century, it chafed at interference and bad government. In 1898 the *United States* stepped in. After the Battle of Santiago, Cuba came under the protection of the United States until 1902, when it became an *independent republic*. Spanish descendants and negroes form the bulk of the population.

HAITI has been even more unfortunate than CUBA in its long history of insurrection and bad government. It was the

first of the islands to be colonised by Spaniards; the French secured the western section (HAITI) toward the end of the seventeenth century; the Spaniards retained the eastern and larger section (SAN DOMINGO). The two sections now form twin republics within one small island. Negroes and mulattos far outnumber the white population.

Port au Prince, the capital of Haiti, recalls the French footing gained in the island. *San Domingo* (the Spanish form of Saint Dominic) is the capital of the less prosperous republic of the east.

In addition to some *tobacco* and *sugar*, much *coffee* is grown in this island.

PUERTO RICO, once, like the rest, a *Spanish* colony, became a possession of the *United States*, after the Spanish-American War of 1898. *San Juan* is the port and capital.

JAMAICA is the largest **British possession** in the West Indies. It was taken from the Spaniards in the middle of the seventeenth century, during Cromwell's administration. *Tobacco* is an unimportant crop in this island. *Sugar* and *coffee* are the principal productions. *Jamaica rum* is a bye-product of the sugar.

The sugar industry has declined owing to severe competition from the *beet-sugar* of the European plain. *Fruit-culture* is profitable. The island is subject to severe *earthquakes*. *Kingston*, the capital, has only in recent years (1906) suffered. The old capitals, *Port Royal* and *Spanish Town*, had previously experienced a similar fate.

The curved chain of small islands linking the **Greater Antilles** with the coast-range of the South American Continent is called the **Lesser Antilles**. The islands of the group all resemble one another in being *volcanic peaks*, rising from a submarine ridge. They enjoy the same climate; they yield the same productions, chief among which are *coffee*, *sugar* and *lime-juice*. They have wet summers accompanied in the

hottest months by devastating hurricanes, and dry winters; *i.e.*, the climate is *monsoon* in type.

Several of the islands are fringed with *coral reef*, whilst some are completely enveloped in coral-rock. The *warm oceanic currents*, bearing food, approach these *mountain-stumps*, which serve excellently the necessary conditions for coral colonies.

Barbados and **St. Yincent** are the most interesting of the British members of the group. The eruption of *La Souffrière* in the latter island, coincident with the more serious eruption of *Mont Pelée*, in the French island of **Martinique**, will be easily recalled by the student. Barbados is a veritable garden on a coral soil.

Trinidad stands outside the group, as an outlier of the South American coast range. It is famed for its pitch-lake.

The coral-island group of the **Bahamas** contrasts in many ways with the islands of the archipelago. They are low in elevation and monotonous in scenery. Rivers and streams are absent, owing to the porous nature of the rock. Rain-water has to be used for drinking purposes. The climate is hot, but delightful, varying little throughout the year; the islands are becoming popular as a winter *health-resort*.

Watling Island is the original *San Salvador*, where Columbus first touched American soil in 1492.

Nassau is the headquarters of government in the British group.

Away to the north-east, ... the Atlantic, is the smaller coral group of the **Bermudas**, used as a British naval base. *Hamilton* is the capital.

Both the Bahamas and the Bermudas grow *fruits* for the American markets.

GREENLAND.

A GLANCE at the map reveals Greenland as the largest member of the Arctic Archipelago lying off the north coast of the North American Continent. It is the only island of the group which does not belong to the Dominion of Canada. Scandinavian explorers reached it from Iceland long before Columbus discovered America, and they even touched Labrador from Greenland as a base. The population are still under Danish control.

Greenland is separated from the lands of the Canadian Dominion by the shallow Davis Strait; the shallow sea separating it from Europe is much wider. *Iceland*, rising out of the sea, is an outlier of Europe, whilst *Greenland* is an outlier of the American continent. Both stand on the broad *submarine platform* which divides the polar oceanic basin from the deep Atlantic trough.

Cape Farewell is in the latitude of our Shetland group.

Mercator's map gives an absurd notion of the size of Greenland. On the highest estimate, this little explored country is less than half the size of India. Mercator should be corrected by comparison on a globe, or on Mollweide's correct-area map. The country lies hidden under a mantle of ice, except for a green strip along the southern shores. It represents an old plateau-block of crystalline rocks, with horizontal sediments of younger age, preserved under sheets of lava (*cf.* Iceland), and these in turn buried under ice.

Bare mountain peaks, some of them of Alpine altitude, merge through the ice-cap as "nunataks." Rivers flow in beds carved in the ice-covering, and drain to the innumerable

fiords, where the ice-cap terminates in tongue-like glaciers, which give rise to ice-bergs. The fiords are on a scale surpassing that of Norway, some of them penetrating for nearly 200 miles inland.

Climate varies as much over this island as over the whole Dominion of Canada.

Extremes are not so great as at Winnipeg; the average temperature is, of course, lower. The short summer cannot counteract the long, severe winter.

The S.E. coast of the island suffers, like Labrador, from an *Arctic drift*, which makes the shore uninhabitable. The S.W. coast is favoured by the *Atlantic* northward-moving drifts, and so supports the small population of 10,000 which subsist on the island. These are Eskimos of good type. The few Europeans are chiefly Danish officials. The interior of the country affords no resources. Hunting and fishing are the primary occupations. Two remarkable minerals are exported—cryolite and the iron of *Ovifak*, on Disco Island, just off the S.W. coast.

Cryolite (ice-stone) is an ore of aluminium, containing fluorine and soda.

The Ovifak iron is found in large "nuggets," which have suggested to some a "meteoric" origin, and the composition is not unlike that of meteoric iron. On the other hand, the Ovifak *basalt* is very rich in iron, and these masses may be simply more basic parts of the basalt.

The population are grouped in villages along the shores of Davis Strait, *outside the Arctic Circle.*

Typical Exercises on the Maps.

(1) Find the area of (*a*) Texas, (*b*) the Great Lakes and (*c*) Nova Scotia by means of transparent squared paper ($\frac{1}{10}$ in. squares).

(2) Mark on the map of North America the 1000 ft. contour-line and the 100-fathom line.

(3) Draw sections, by aid of a contoured map:—

(*a*) From Vancouver to Winnipeg;
(*b*) From San Francisco to the Mississippi (due east);
(*c*) From Toronto to New York.

(4) On a blank map of North America, insert the courses of the St. Lawrence, the Hudson, the Saskatchewan, the Missouri-Mississippi and Ohio, the Colorado and the Columbia Rivers. Mark the regions of greatest rainfall, the areas of extreme summer and winter range, and the direction of ocean currents.

(5) Give a sketch-map of (*a*) the Atlantic States from Boston to Baltimore, (*b*) the Ohio-Alleghany plateau, (*c*) the St. Lawrence valley, (*d*) the gold-mining valleys of British Columbia, (*e*) the "Cotton" States, (*f*) the West Indian Archipelago, (*g*) the Pacific States, (*h*) the "Food" States around the Upper Mississippi.

(6) Trace the four main railways which cross the continent from the Atlantic to the Pacific. Describe the varied country crossed by the Canadian Pacific Railway, the Central Pacific Railroad and the Southern Pacific Railway.

(7) Analyse the position and account for the importance of the following cities:—

Montreal, Toronto, Winnipeg, Victoria (B.C.), New York, Philadelphia, Chicago, St. Louis, New Orleans and San Francisco.

(8) Describe in detail any of the following:—

The Great Lakes; the Colorado Plateau; the Yosemite Valley; the Mexican Tableland; the Hudson Bay Depression; the Lesser Antilles.

(9) From what regions of the continent do we get nickel, gold, oil, cotton, cattle, maize, wheat, anthracite, timber, furs and sugar? What towns are engaged in the collection and export?

SECTION V.

THE BRITISH EMPIRE

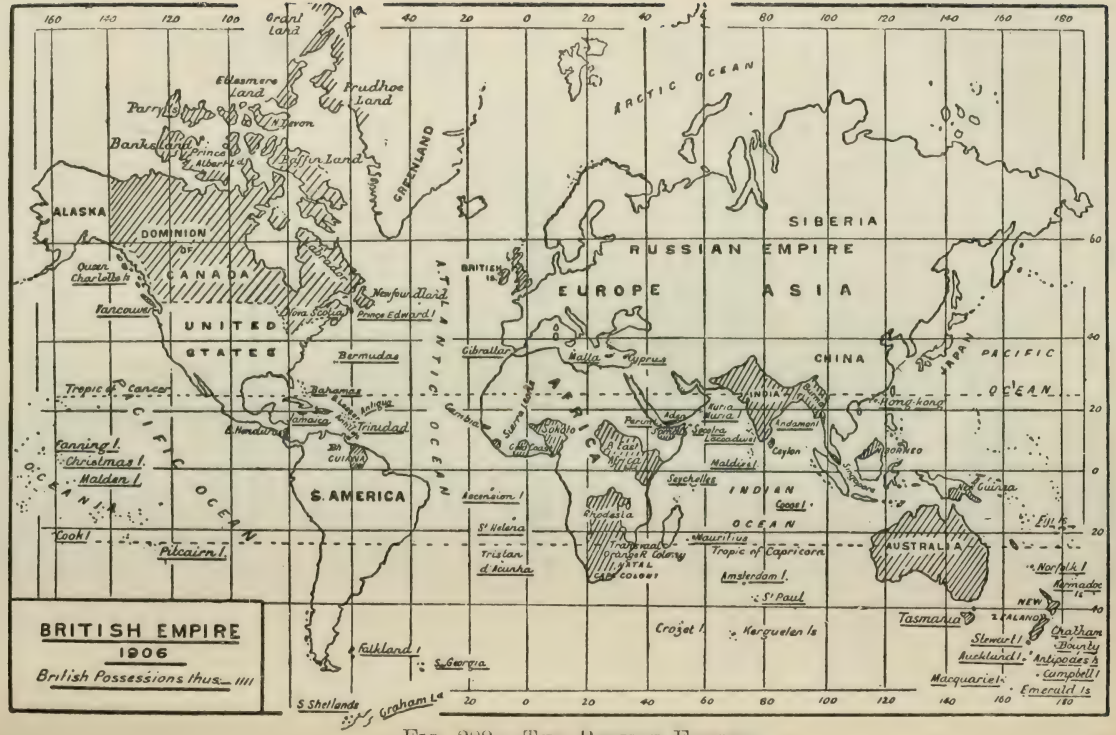


FIG. 288.—THE BRITISH EMPIRE.

THE BRITISH EMPIRE.

CHAPTER I.

The British Empire: Its Extent and Distribution over the World's Surface. Statistics of Population.

[Maps to be studied: The Globe and Population Maps; Mercator's Map is to be avoided in comparing areas.]

THE dominions of King George the Fifth (1913) cover an area nearly one hundred times that of the British Isles. Whilst our islands occupy one-eighth of a million square miles, our North American dominions cover nearly four millions, our Australian possessions more than three millions, our African territories well nigh two and a half millions, and our Asiatic dependencies close upon two millions of square miles. Our South American colonies just about equal our United Kingdom in area. In Europe we have only the "stepping stones" of Gibraltar and Malta, important far beyond their size as strategic points on the highway to the East.

A glance at the map of the British Empire shows how practically every line of *latitude*, from the Arctic Circle of the North to the Antarctic Circle of the South crosses, at some

point or other, a portion of the British Empire. The reader will realise what this fact alone means in *variety of climate, productions, resource and race.*

It is almost equally correct to say that in every *longitude* we have territories owning our sway. Hence the boast that ours is an empire on which the sun never sets. "It is always morning somewhere" in the British Empire.

Canada is the only British possession in the same latitude belt as the British Isles. It stretches through 90° of longitude and 45° of latitude, and, including **Newfoundland,** covers an

FIG. 289.—THE LANDS AND SEAS OF THE DOMINION.

area of three and three-quarter million square miles, or more than thirty times the area of the United Kingdom.

It extends in the St. Lawrence Basin some 8° farther south than Land's End, and pushes as far within the Arctic Circle as explorers have been able to carry the flag.

The **Mediterranean highway** is outside the Northern Tropic but in the warm belt of the Temperate zone.

Gibraltar, *Malta* and *Cyprus* have a common latitude of 36° N.

The *Bahamas* and the *Bermudas*, *Lower Egypt*, and the plains and ranges of *Northern India*, lie outside the Tropics, though our knowledge of their climate and productions would scarcely suggest it. Here we get a hint that *climatic belts do not always coincide with belts of latitude*; this question is discussed in Chapter III., and more fully in Part I., the introductory section of this book.

The northernmost point of India is actually in a higher latitude than Gibraltar, and only 5° nearer the Equator

FIG. 290.—WORLD POSITION OF THE INDIAN EMPIRE.

than New York. Including *Ceylon* and *Burma*, our Indian possessions occupy an area more than fifteen times that of the British Isles, or just about half that of the Dominion of Canada. *The Equator nowhere intersects our Indian Empire.*

Within the Tropic belt fall our colonies in *the East and West Indies*; the mainland territories of *Guiana*, *Gambia*, *Sierra Leone*, *Ashanti*, and *Nigeria*, all rich in tropical forest yielding oil and rubber; the upper basin of the *Nile*, the plateaux of *East* and *Central Africa*, the *Zambesi* tableland,

the peninsular *Deccan* (S. India), and nearly half (N.) of the continent of *Australia*. Nowhere do plateaux and coastlands afford such *striking contrasts* as within the Tropic belt.

Beyond the southern Tropic lie the more highly developed sections of our South African and Australasian possessions—*Cape Colony*, *Natal*, the *Orange River Colony*, and the

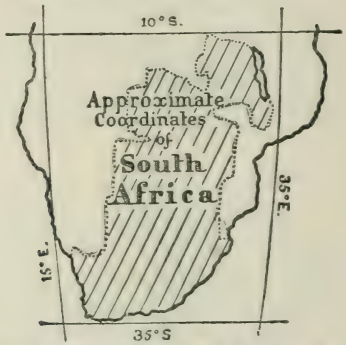


FIG. 291.—WORLD POSITION OF OUR SOUTH AFRICAN COLONIES.

Transvaal, *West Australia*, *South Australia*, *Victoria*, *New South Wales*, the southern half of *Queensland* and the islands of *Tasmania* and *New Zealand*. The *Falkland Islands* mark

FIG. 292.—WORLD POSITION OF OUR WEST AFRICAN COLONIES.

the southernmost station on our trade routes. *South Georgia* lies within the Antarctic Circle.

Cape Colony and **Natal** together cover nearly three times the area of the British Isles. The *Transvaal* is as big as the United Kingdom. *Rhodesia* is five times and *Nigeria*

three times the area of our islands. Our South American colonies almost equal in area the home country.

FIG. 293.—WORLD POSITION OF THE AUSTRALIAN CONTINENT.

Australia is continental in dimensions, and half as big again as the sum of our possessions in Asia.

New Zealand and the *British islands in the Pacific* together approach our British archipelago in area.

Distribution of Population.—The *British Isles* support a population of nearly forty-five and a half millions, or $\frac{45,500,000}{120,000} = \frac{4550}{12}$, or 379 persons per square mile. Of course, these are not evenly distributed over the land.

Our *Asiatic dependencies* teem with native population, reaching the enormous total of three hundred and twenty-two and a half millions, or over three-fourths of the whole population of our British Empire. Nevertheless, the density

of population is little more than half that of our island, being, roughly, $\frac{322{\cdot}5 \text{ millions}}{2 \text{ millions}} = 161$ per square mile.

Australia, with its three millions of square miles, has only some four million inhabitants, chiefly Anglo-Saxon colonists. The density of population thus works out at $\frac{4}{3}$, or 1·3 per square mile. This is explainable by the *uninhabitable nature* of a large part of the Australian *interior*. Australia is yet young as a member of the British Empire, practically only dating back to 1851, the period of the "gold rush," within the memory of many persons still living (1908). The coast lands and the basins of the eastern interior are capable of supporting a much larger population, and may do so in course of development.

Africa is very densely peopled in the Tropic belt. *Nigeria* alone supports four times as many people as the whole continent of Australia, though only one-tenth of the area. The great bulk of the population are *negroes*. At least five "cities" exceed fifty thousand in population.

Uganda, on the Central Lake Plateau, is similarly densely peopled.

Cape Colony numbers two and a half million inhabitants; *Natal* one million, and the *Transvaal* one and a half million.

Rhodesia, five times the area of the Transvaal, only supports the same number of people.

South Africa—from the Zambesi to the Cape—with an area of one and a half million square miles, supports some six million inhabitants, or, as things at present stand, four persons to the square mile. The Veldt, by far the most thinly peopled portion of South Africa, awaits development.

North America is chiefly given over to British colonists, our American cousins being the lineal descendants of the colonists who separated from the mother country in 1776. In *Lower Canada* and the *Southern States of the Union*, a strong *French* element persists.

Canada, owing to its rigorous climate and ice-locked coasts, is much less developed than the eastern states of the Union. A country of rich resources, covering an area of three and three-quarter million square miles, it can support an immeasurably larger population than the seven million people who are aggregated chiefly along the St. Lawrence highway and the Canadian Pacific route.

Little *Jamaica* supports three-quarters of a million, largely negroes; or one hundred and eighty to the square mile.

South Africa, Australia, and Canada thus offer most opportunity for development by an expanding population. Climate, resources, both agricultural and mineral, and the comparative absence of hostile or backward races, all augur well for their prosperity under British rule.

TABULAR VIEW OF THE PRINCIPAL MEMBERS OF THE BRITISH EMPIRE (1912),

(For reference only.)

			Roughly: pr. sq. mile.
NORTH TEMPERATE ZONE.	(*a*) DOMINION OF CANADA.	7 million people / $3\frac{3}{4}$ million sq. mls.	1·8
	(*b*) BRITISH ISLES	$45\frac{1}{2}$ million people / $\frac{1}{8}$ million sq. mls.	364
TORRID BELT.	(*c*) West Indian Islands (Br.)	$1\frac{3}{4}$ million people / $\frac{1}{20}$ million sq. mls.	35
	(*d*) West and Central African Colonies	32 million people / 1 million sq. mls.	32
	(*e*) Rhodesia	$1\frac{1}{2}$ million people / 1 million sq. mls.	1·5
	(*f*) India and the East Indies	317 million people / 2 million sq. mls.	158
SOUTH TEMPERATE ZONE.	(*g*) South Africa	6 million people / $\frac{1}{2}$ million sq. mls.	12
	(*h*) Australia	$4\frac{1}{2}$ million people / 3 million sq. mls.	1·5
	(*i*) New Zealand	1 million people / $\frac{1}{10}$ million sq. mls.	10

CHAPTER II.

How we got our Empire: Exploration; Conquest; Colonisation.

With the *loss of Calais*, in 1558, England parted with the last of her old possessions on the continent of Europe.

Shut out of Europe, she began to share in the adventurous spirit of the *Age of the Renascence*, and to sail abroad to make new conquests and settle new lands.

The *golden age of* **Elizabeth** saw many English sailors like **Drake, Frobisher,** and **Raleigh**, venturing to dispute the rights of Spain on the Atlantic; and quarrels between Spain and England culminated in the struggle for supremacy on the sea, which was decided in favour of England by the complete failure of the *Invincible Armada* (1588).

John Cabot, of Bristol, a Venetian pilot in the pay of Henry VII., had discovered *Newfoundland*, in 1497. He and his son were granted a portion of *Cape Breton Island*. From this base the Newfoundland fisheries were established. **Sir Humphrey Gilbert** took possession of St. John's harbour (Newfoundland) in 1583, and several futile attempts at colonisation followed. An attempt at colonisation further south, in *Virginia* (so called after Queen Elizabeth), failed in 1585, but was followed by comparative success in 1607.

Whilst *Spain* had appropriated the principal islands of the West Indies and exploited the mineral treasures of Mexico and Peru, *Portugal* had, in obedience to the papal Bull, skirted the coast of Africa, rounded the Cape, and reached India and the Eastern Archipelago.

As **Cabot** emulated **Columbus,** so British sailors, not recognising the authority of a papal Bull from Elizabeth's time onward, voyaged in the tracks of both Spanish and Portuguese navigators.

Barbados was reached in 1605, but not colonised till 1625. Meantime, *Virginia* had been recolonised, under a chartered company, in 1607, and the *Bermudas* occupied by Admiral Somers in 1609.

Following the Portuguese, who had already gained a foothold in *India* at their stations of *Goa, Calicut, Diu, Cananore* and *Cochin,* the British established a trading factory at *Surat* (1612) and an inland station at *Agra,* as an outcome of the charter granted, in 1600, to the East India Company.

The **seventeenth century** saw the British firmly established in the *West Indies,* possessed of stations on the unhealthy *West African Coast* and settled in *Bombay, Madras,* and *Calcutta,* the three bases from which they have gradually gained the mastery of India.

Equally, if not more important, was the founding, by the *Pilgrim Fathers* and their religious *confrères,* of the *New England Colonies* in 1620, the settlement of the middle states, captured from the Dutch in 1644 by *Quaker Colonists,* and the starting of trading factories in the *Carolinas* during the Commonwealth and Restoration (1629-70). Though lost to Great Britain, constitutionally, since the *Declaration of Independence* (1776) and the *Treaty of Paris* in 1783, the thirteen colonies remain the brain and heart of the English-speaking American Commonwealth.

Our West Indian conquests from Spain remain to us—the *Bahamas,* colonised in 1629; *Jamaica,* captured in 1655, and *Honduras,* ceded by Spain in 1670.

A station on the *West African Coast* was established as early as 1631 by Exeter merchants, whose charter dated back to the year of the Armada. *Bathurst* was founded in 1664.

Three years before, the *Gold Coast* had been touched by British traders.

In 1672, a company secured a charter empowering their development of this West African Coast.

A contest with Dutch sailors, in 1672, finally gave the island of *St. Helena* into British hands. It had been occupied by the East India Company as early as 1651.

Of the three foci on our Indian territory, *Madras* (called Fort St. George) was the first to be established (1639); it lay nearest to the trade-routes to the East Indies. *Bombay* was already a Portuguese settlement, and became British as part of the dowry of Catherine of Braganza, on her marriage to Charles II. of England, in 1662, just fifty years after the founding of Surat. *Calcutta* (Fort St. William) was settled four years before the close of the century (1696), though the neighbouring factory of *Hooghly* had existed since 1640.

Whilst British sailors were developing trade with the warm countries within the Tropics and with the comparatively near American seaboard, other more daring navigators, bent on exploration rather than trade, had penetrated to *Hudson Bay*, and by 1670, set up trading factories at the mouths of the inflowing rivers.

The **eighteenth century** is chiefly remarkable for the development of strong nationalities on the continent of Europe and the consequent *rivalry for empire.* War succeeded war to decide the mastery. *England and France* were the foremost antagonists. The century closed with France, under *Napoleon I.*, dominant on the continent of Europe, but *England mistress of the seas*, firmly established in India, supreme in *Canada*, and occupying the *St. Lawrence Valley* from *Newfoundland* to the *Lake of the Woods.* The early part of the century saw but little expansion of our colonies.

Gibraltar was an important conquest from Spain in 1704, when the *War of the Spanish Succession* was in progress to

Important Dates in North American History:
1713 Close of the War of the Spanish Succession. Treaty of Utrecht.
1763 " " Seven Years War. Treaty of Paris.
1783 " " American War of Independence. Treaty of Versailles.
Hudson Bay Company formed 1670 British since 1713
NEW FRANCE
CANADA after 1763
Acadia
British after 1713
French till 1763
Spanish after 1763
French in 1800
U.S.A. 1803
French till 1763 British after 1763 United States after 1783
The Thirteen Original Colonies Declared Independence 1776 Recognised as U.S.A. 1783
British after 1763
Spanish " 1783
U.S.A from 1819
90
80
70
60
50
40

FIG. 294.—HISTORICAL SKETCH MAP OF NORTH AMERICA.

decide whether the Dauphin of France should disturb the balance of power in Europe by seizing the Spanish throne, the right to which he had resigned by treaty in 1798.

This war not only gave us Gibraltar, but also *Minorca* in the Western Mediterranean; it also secured to us *Newfoundland* by the *Treaty of Utrecht*, which brought the war to a close in 1713.

The next war (1741-48), waged to decide the *Austrian Succession*, brought no increase of territory, but the struggle made clear that England was now supreme upon the seas.

The Seven Years' War (1756-63) far more seriously affected the welfare and development of the British Empire. *North America* and *India* were at stake. France had strong interests in both countries, and was designing to oust Great Britain from India, as well as to hem her in along the Atlantic seaboard of America by joining up her two lines of forts along the Mississippi and the St. Lawrence. The elder Pitt planned to keep France fully engaged in her continental struggle with Frederick of Prussia, whilst he secured the control of the sea and mastered the French in America. 1759 saw the capture of *Quebec* by Wolfe, and 1760 the fall of *Montreal*, which left Great Britain in possession of *Canada*. *Minorca*, lost to the French in 1756, was exchanged for Belle Isle in the peace of 1763, and so became once again a British station.

Whilst the Austrian Succession was hanging in the balance, war had broken out in the *Carnatic*, the shore-country behind Madras. The decay of the Empire of the Great Mogul, following upon the death of Aurungzebe in 1707, had led to disorder and native risings. The French Governor, **Dupleix**, whose headquarters were at *Pondicherri*, quite close to Madras, made full use of the opportunity to harass the British, and war became inevitable by 1750. **Clive**, a clerk in the service of the British Company at Madras, took up arms, laid siege

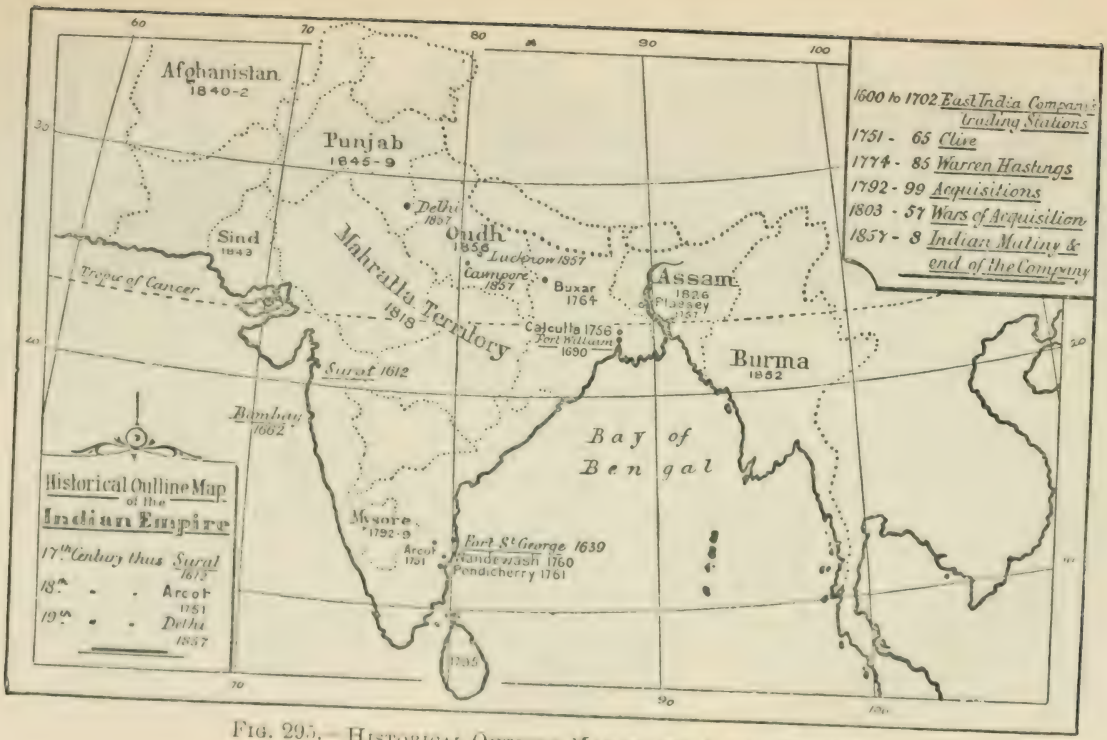


FIG. 295.—HISTORICAL OUTLINE MAP OF THE INDIAN EMPIRE.

to *Arcot* in 1751, and by the end of 1752 had undermined French power in South India.

At the outbreak of the *Seven Years' War*, *Surajah Dowlah*, urged on by the French, fell on Fort William (Calcutta), and rendered his name infamous by the incident of the "*Black hole of Calcutta.*" Clive set out to avenge the deed, and ensured British supremacy in the lower Ganges country by his victory at *Plassey* in 1757. For a time the French promised to regain their position in South India, but **Sir Eyre Coote** finally disposed of any such danger by his victory over Lally at *Wandewash* and the capture of *Pondicherri* (1760-1).

The year 1763 saw France completely mastered in America and effectively subdued in India. But the struggle was to assume new forms in India, and the subsequent history of the thirteen American colonies, whose expansion westward the French had tried to limit, to take an unexpected turn. Scarcely a year had passed when a rising in Bengal was quelled at the battle of *Buxar* (1764). The following year Clive, who had come home, was sent back to reform abuses and organise the work of the Company—producing order in the north as he had previously done in the south.

After five years of peace, *Hyder Ali*, the ruler of Mysore, attacked the English. **Warren Hastings** was sent out as Governor-General of India. The rebellion was crushed by the veteran *Eyre Coote*, in 1780, and in 1783 Hyder Ali's successor, the warlike Tippoo Sahib, made terms of peace. Pitt's *India Bill* of 1784 gave the home government political control in India.

The thirteen colonies were, after 1763, free from French encroachment or resistance; they could expand westward to the *Mississippi*, beyond the *Alleghany* ranges. As colonies, according to the prevalent ideas of the age, they were bound to the dictates of the home government.

They might not trade with foreign nations; their exports and imports must be exchanges with Great Britain. This

was a hardship; but what the colonists resented even more were the attempts (from 1765-69) of the Exchequer in London to tax the colonies, who were not represented in the British Parliament. George III.'s ministers insisted on the *right to tax* (they based it on the fact that the colonies had been saved from French aggression, and were protected by a squadron of the British fleet); the colonists fought for the principle of "*no taxation without representation.*" The irritation increased, provoked by both sides, until, in 1775, war broke out by *General Gage* attacking the colonists' stores at *Concord*, near Boston, Massachusetts. **Washington** led the colonists. France and Spain offered assistance. American *Independence* was declared in 1776 (July 4th, since kept as Independence Day), and ratified by treaty at *Versailles* in 1783. The United States were no longer colonies of the mother country, but an independent commonwealth. 1763 saw the *acquisition of Canada*; 1783 saw the *separation of the States.*

The closing years of the eighteenth century found England fully occupied with the problems started by the *French Revolution* and the *rise of Napoleon* to power. The First Consul had designs on *India*, and had proceeded as far as *Egypt*, only to be defeated in his aims by **Nelson** at the *Battle of the Nile* (1798).

Sierra Leone had been founded in 1778. Captain Philip (nearly twenty years after Captain Cook) landed in *Botany Bay* in the same year, which act was the first step in the exploration and colonisation of *Australia*. The shores of *Tasmania* and the east coast of the continent had been outlined. *The Cape* had been seized in 1795, but restored to the Dutch, and recaptured in the early years of the new (nineteenth) century—events prophetic of the struggle between British and Dutch in South Africa, which has continued down to the opening years of the twentieth century. *Guiana* had become British by conquest; *Honduras* had been ceded by Spain, and

the Falkland Islands settled before the close of the eighteenth century.

Gibraltar (1704) had been for nearly a century in English hands, when *Malta* became British (1800), having been taken from the French in the Napoleonic wars. The *Treaty of Paris* (1814), at the close of the struggle, allowed Great Britain to retain Malta, although the *Truce of Amiens*, in 1802, had arranged for the island to be restored to the Knights of St. John.

Malta took the place of Minorca as a British station in the Mediterranean. *Minorca* became English under the Treaty of Utrecht, in 1713, five years after its capture by Stanhope; Admiral Byng lost it to the French in 1756; it was restored by the Treaty of Paris in 1763, at the close of the *Seven Years' War*. It was finally captured by Spain in 1782, towards the close of the *American War of Independence*, when England, busied with her struggle with the thirteen colonies, lost many of her *West Indian Possessions* and *Minorca* to Spain, who, along with France, had taken the opportunity of harassing their old enemy.

The latter half of the eighteenth century had been an era of rapid *conquest and expansion*. The **nineteenth century** was rather one of *consolidation and development*. The principal additions to our Empire were on the continent of *Africa* and the *Indo-Chinese Peninsula*. At the opening of the nineteenth century, our West Indian possessions were the same as those of to-day. Gibraltar and Malta were in our hands. Canada was awaiting development, and India, from Ceylon to the Ganges, with the bulk of the Ganges basin, was under British rule. French influence was restricted to a few trading factories in Southern India. [True, Napoleon had designs on India, but they were spoiled, as we have seen, by Nelson's victory at the Battle of the Nile in 1798.]

The new century opened with wars with the Mahratta tribes of the *Deccan*, and these were followed by a series

of similar struggles, culminating in the Indian Mutiny in 1857 and the taking over from the East India Company of the control of *India* by the Crown in 1858. Later wars were waged on the African frontier to the west and the Burmese frontier to the east.

Canada found herself at war with the United States in 1812, owing to acts of aggression on the part of the Commonwealth, prompted by Napoleon, who was losing against Wellington in the Peninsular War, and had disastrously failed in Russia. By the time the quarrel was ended in Canada, Napoleon had abdicated, and was a prisoner in Elba. From this time onward *Canada* expanded. Railway construction began in 1836. **Lord Durham** was sent out in the year of Queen Victoria's accession to settle political difficulties, which were due largely to the fact that the settlers of Lower Canada were chiefly French, whilst those of Upper Canada were British. 1840 saw the difficulties settled, and a form of "home rule" inaugurated. The provinces of the East united to form the *Dominion* in 1867; three years later, *Manitoba* joined, and in the following year *British Columbia*.

The building of the Canadian Pacific Railway (completed in 1885) led to the settlement of the western provinces, and branch lines thrown off towards the north-west have carried colonists as far north as latitude 60° N.

The history of our occupation of *South Africa* dates from the early years of the nineteenth century, as does likewise the colonisation of *Australia*, following upon the journeys of Captain Cook (d. 1778).

The Cape had been conquered from the Dutch in 1795, but restored in 1802 in the Truce of Amiens. The truce was no peace; war again broke out. Our permanent possession dates from 1806, when it was retaken. At first it was deemed serviceable only as a station on the route to India. After conquest followed colonisation, and the racial problem (as in Canada) presented itself. Briton and Boer differed in their

views as to the treatment of the native races. The quarrel led to the great Boer trek of 1836, and the British pushed along the coastal belt, reaching *Natal* by 1838. 1856 gave Natal a separate constitution; self-government was secured in 1893. Five years later, *Zululand*, after giving much trouble, was annexed to Natal (1898).

West of the *Orange Free State* and the *Transvaal*—then Boer republics—British enterprise (represented by the Chartered Company) was gradually pushing along the veldt towards the Zambesi.

Bechuanaland was acquired in 1884 and *Matabeleland* in 1888.

The British have now pushed their control as far as the great lakes of Tanganyika and Nyassa.

Dutch outnumber British by five to one in South Africa. The Boers are farmers; the discovery of gold and diamonds, mostly within Dutch territory, drew many British over their frontiers. Political conflict ensued.

An earlier war gave favourable terms to the Boers, who retained their republics. The war which came to an end with the *Peace of Vereeniging* in 1902 deprived the Boers of self-government, and opened up the possibility, fraught with *racial difficulties*, of a confederated South Africa from the Cape to the Lakes.

Modern Exploration in Tropical Africa.—The last years of the eighteenth century and the beginning of the nineteenth saw an attempt to explore the Niger basin by way of the Gold Coast. In 1797 **Mungo Park** lost his life in the river. *Timbuktu* was the goal of explorers. In 1800, an expedition crossed the desert from *Tripoli*; in 1819, *Lake Chad* was discovered; not till 1880 was Timbuktu gained from the Atlantic shore.

Whilst Mungo Park was tracing the Niger, the British gained a lodgment in S. Africa by conquest (1795). By 1812

FIG. 296.—HISTORICAL MAP OF SOUTH AFRICA.

they had spread along the coast belt. In 1837 the country north of the Orange delta was explored.

But the greatest triumphs of exploration began with **David Livingstone**, the missionary, who entered the continent in 1840 by way of the *Zambesi*; these triumphs are chiefly associated with the *Lake plateau of East Africa* and the solution of its *drainage* to the Nile, the Congo or the Zambesi. In that year Livingstone reached the Zambesi from the south; by 1853 he had traced the river throughout its length; 1858 saw him on the shores of *Lake Nyassa*, and in 1865 he arrived at *Nyangwe*, the meeting place and general mart of the Arab traders, on the Upper Congo. It remained for **Stanley,** who first went out in 1871 to discover Livingstone, about whom nothing had been heard for some time, to clear up *the Congo problem* by making his way to the mouth of the river from Nyangwe, quite 2,000 miles from the sea.

Whilst Livingstone was pushing forward and inward from the south, **Burton** and **Speke** were penetrating the lake-plateau southward by way of the Nile. *Lake Tanganyika* was discovered in 1858, and, on the return journey, the broad lake of *Victoria Nyanza*. **Baker,** another explorer bent on elucidating the Nile hydrography, found *Lake Albert Nyanza* (*nyanza*=water).

The *volcanoes* of East Africa have proved of great interest to scientific geographers, and have given rise to expeditions to their regions. **Dr. J. W. Gregory** made the first ascent of Mt. Kenia, on the Equator, 14,000 feet higher than Mt. Blanc. Its snow-cap was believed by the natives to be a cone of silver.

The *Gambia River* settlement, *Sierra Leone*, *Ashanti* (the outcome of the Gold Coast settlement), and *Nigeria*, acquired from the original base of Lagos, represent our possessions in the tropical forest belt. The climate is trying to Europeans, and the English population is small in proportion to the native.

Modern Egypt and East Africa.—Great Britain commands the Nile from mouth to source. Egypt proper, below Wady Halfa, is nominally under *Turkish* suzerainty, but the *importance of the Suez route* is so great that France and Great Britain, the dominant partners in the Canal, have interfered. From 1811 onward the *French* were supreme, but in 1882 military disturbances led *Great Britain* to bombard *Alexandria* and quell the disturbances by a victory at *Tel-el-Kebir*. The French rendered no assistance, and so since 1882 the British have assumed the protection of Egypt, to the great advantage of that country.

Egyptian Sudan became British at the *fall of Khartum* in 1885, at the hands of Lord Wolseley, who arrived too late to relieve **General Gordon.** But rebellion revived, and Lord Kitchener followed with the final victory at *Omdurman*, in 1898.

British East Africa, whose boundaries were settled by agreement with Germany in 1888, opens up a short way from the Nile sources to the ocean. The islands lying off the German seaboard are under British control. *Zanzibar* is the most important station on the East African coast.

Six hundred miles of German territory separate the Nile-extension of British territory from the South African line of advance. Otherwise, a line of British rule quite 5000 miles in length would be established ($\frac{7}{36}$ of 25,000 miles=nearly 5000 miles).

The important *trade route of the Red Sea* is secured for Great Britain by her *dominant share* in the *Suez Canal*, her possession of *Perim Island*, the military station of *Aden* and *British Somaliland* (acquired in 1884).

The History of Australia practically begins with the nineteenth century. The Portuguese first sighted it in 1542. The early Dutch navigators had discovered an uninviting land, which they afterwards called New Holland, as early as 1580. This was the western half of the Australian continent, nearest

to the Cape, and due south of the East Indies. **Dampier** touched this land in his buccaneering voyages in 1688. **Tasman,** a Dutch sailor, had touched what we now call *Tasmania*, as early as 1642, although he did not recognise it as an island. He also reached New Zealand in search of the fabled continent of "Australis." He had sailed to the south of New Holland in those journeys.

Captain Cook was the first to approach the continent from the east. His vessel had been chartered for astronomical observations (*e.g.*, the transit of Venus) in the south seas. He landed in Botany Bay in 1770, and being struck with the variety of wild flowers on its slopes, gave it the name it bears. The east coast of the continent proved more inviting than the west, and in 1788, fifteen years after Cook's death from violence at the hands of Tahitian natives in the South Sea Islands, five years after the United States had finally separated from Great Britain, and on the eve of the French Revolution, **Captain Philip** established a convict settlement on the site of *Sydney.* Such was the inauspicious beginning of one of the finest cities in our Empire. Ten years later, **Captain Bass** proved what Tasman had not suspected, that *Tasmania* was an island cut off by a broad sea channel, to which he gave his name.

The outline of the Australian continent and the location of *New Zealand* were thus fairly defined at the opening of the nineteenth century. The subsequent history is one of exploration and colonisation rather than one of conquest. Except in North Island, N. Z., the native races (the aborigines of Australia and the Maories of N. Z.) offered little resistance. No European settlers, like the Dutch in South Africa, were already on the ground to dispute with the British the right of advance.

Sydney was the base of development. The colony which Governor Philip had founded was called by Captain Cook "*New*" *South Wales,* because the hills of the seaboard

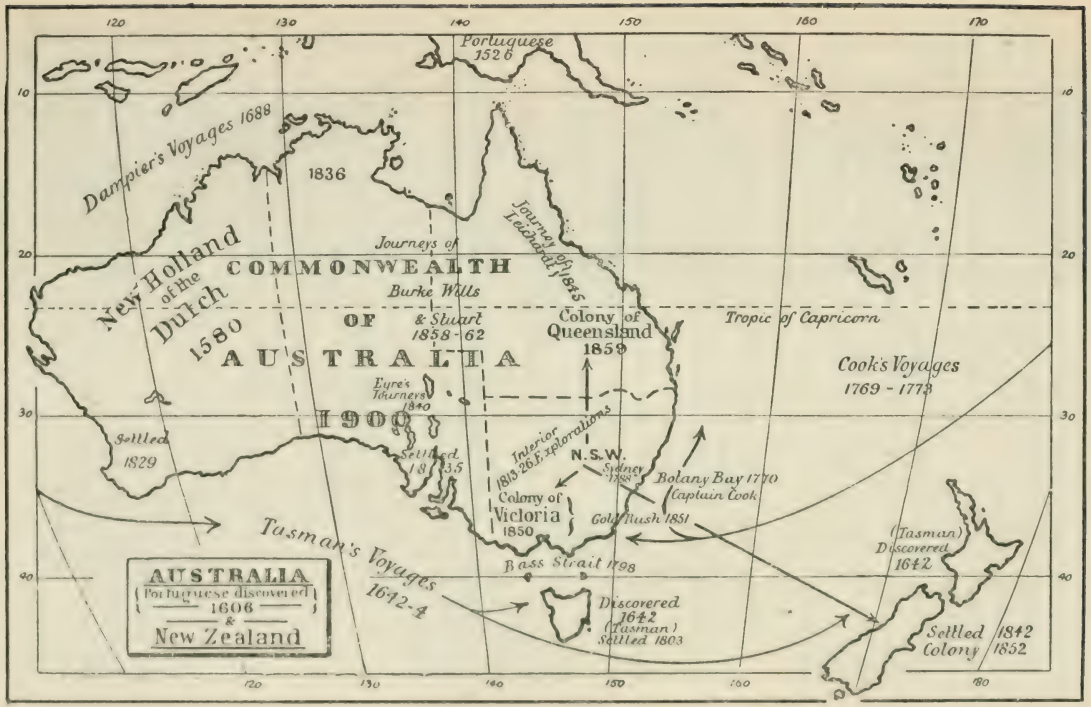


FIG. 297.—HISTORICAL SKETCH MAP OF AUSTRALIA, TASMANIA, AND NEW ZEALAND.

reminded him of those of South Wales, with which he was familiar through sailing to and from the port of Bristol.

A long mountain wall ran parallel to the coast. Development therefore proceeded along the coastal strip. Settlements were made at various points, where coves and fertile basins opened inland from the coast. A venture was made over the mountains to the interior in 1813, and by 1826 the drainage basin of the *Darling-Murray system* was known. Its suitability for sheep-farming was easily recognised, and the merino sheep, already thriving on the coastal plain, was introduced.

From being a penal settlement, New South Wales became a military station, and, finally, with the growth in the number of colonists and the prospects of prosperous sheep farming, the colony was reorganised in 1823, under the governorship of **Brisbane.** Following him were governors who gave their names to the new discoveries and settlements which were constantly being made (Darling, Bourke, Gipps).

South Australia had been reached and settled by the South Australian Colonisation Society when Queen Victoria ascended the throne. *West Australia* had made a start even earlier.

Tasmania, which had an independent footing, had proved itself by climate and soil a very suitable ground for British farmers.

Down to the middle of the nineteenth century possibilities of sheep farming and agriculture had been the principal attraction to colonists. The transport of convicts to New South Wales ceased in 1840; colonists spread from Sydney southward along the shores of the Bass Channel and (later) northward to the hotter latitudes of *Queensland,* which had been explored by **Leichardt** in 1845. Meantime, others had ventured across twelve hundred miles of sea to settle in *New Zealand* (1842). As yet all the newer settlements were governed from Sydney.

Melbourne dates back to the founding of Port Philip, in 1837. After thirteen years of chafing at government from Sydney, the colonists of the south were given a separate governor. The following year (1851) was the year of the "Gold Rush," for adventurous spirits who had sailed to

California on the discovery of gold there in 1849, and had noticed the similarity of geological structure of the mountain system of California to that of their own adopted country, returned to Victoria, only to find their reasonings confirmed. Gold dust worth the working was present in nearly every river bed. Soon the southern colony swarmed with diggers (65,000 immigrants landed within a year). Next. gold fields were opened up in New South Wales. All the colonies developed rapidly. The agricultural colonies exchanged their produce with the diggers.

New Zealand was constituted a separate colony in 1852 and *Queensland* in 1859.

Burke, Wills and **Stuart** were pushing north-west on to the arid Australian plateau (1860). **Eyre** had, twenty years before, explored the salt basin of South Australia beyond the Flinders range.

The middle years of the century (1850-52) had seen the eastern colony subdivided, and separate colonies established; the closing year of the century saw the federation of all the colonies on the Australian continent, with Tasmania, in one vast *Commonwealth* (1901).

The distance between *New Zealand* and *New South Wales* was too great to allow of effective government from Sydney. In 1840, the settlers had come to terms, after a severe struggle, with the Maoris in the TREATY OF WAITANGI (North Island). Two years later, *New Zealand* was virtually separated from the Australian colony, though not till 1852 was the privilege of self-government granted. The intervening years had been occupied by wars between settlers and Maoris over breaches of the treaty.

Two distinct accessions to the New Zealand colony were the Free Church *Presbyterians*, who colonised the south of Middle Island (the Free Church separated from the Established Church of Scotland in 1843), and the *Anglicans*, who, under the guidance of Bishop Selwyn, settled on the fertile plains of Canterbury, in the same island. *Dunedin* and *Christchurch*, their respective capitals, recall their connections with the city of Edinburgh and the foremost of Oxford's colleges.

DATE CHART OF BRITISH EXPANSION.

(For Reference Only.)

	(The Americas. See Fig. 294 and Chap. II.)	The Mediterranean and the Far East. (See Fig. 295 and Chap. II.)	West and South Africa. (See Fig. 296 and Chap. II.)	Australia and the Pacific. (See Fig. 297 and Chap. II.)
Before the 17th Century.	[1492. Columbus.] 1497. Cabot. [1534. Cartier.] 1580. Drake. 1583. Newfoundland settled.			
17th Century.	1606. Virginia Company. 1609. Bermudas. 1620. The Pilgrim Fathers. 1625. Barbados (W.I.). 1646. Bahamas. 1655. Jamaica. 1663. Carolina. 1664. New York Captured. 1670. Hudson Bay Co.	1612. E. India Co. (at Surat). 1639. Madras. 1640. Hoogly. 1661. Bombay. 1690. Calcutta.	1651. St. Helena. 1652. The Dutch at the Cape. 1662. The Gambia Settlement.	1642. Tasman's voyages.
18th Century.	1759. Capture of Quebec. 1760. Canada British. 1765. Falkland Islands. 1776. American Independence. 1796-8. Trinidad, Guiana, Honduras.	1704. Gibraltar. 1757. Victory of Plassey. 1795. Ceylon. 1799. Mysore. 1800. Malta.	1787. Sierra Leone. 1795. England at the Cape.	1770. Cap. Cook occupies New South Wales. 1788. Sydney founded.

			1806. The Cape becomes British.	1803. Tasmania Colonised.
		1810. Mauritius and Seychelles.	1815. Ascension.	
		1819. Straits Settlements.		
		1824. First War in Burma.		
				1829. Swan R. Col. (W. Aus.)
				1835. South Australia.
			1836. Great Trek of Boers.	
		1838. Aden.		
		1841. Hong Kong.		1840. Treaty of Waitangi with Maoris (N.Z.)
			1843. Natal Colony.	
			1843. Gold Coast Colony.	
		1846. Labuan.		
		1849. Punjab.		
				1851. Victoria a separate Col.
				1852. New Zealand Self-governing.
		1856. Oudh.		
		1857. Indian Mutiny.		
19th Century.	1859. British Columbia.			1859. Queensland a separate Colony.
			1861. Lagos.	
		1869. Suez Canal.		
				1871. Fiji Islands.
			1872. Cape Govt. established.	
			1877. Transvaal taken.	
		1878. Cyprus.		
		1881. North Borneo.	1881. Transvaal restored.	
		1882. Battle of Tel-el-Kebir.		
		1884. Somaliland.		1884. New Guinea (part).
			1886. Niger Company.	
		1888. British E. Africa Co.		
		1888. Sarawak.		
			1889. British S. African Co.	
			1890. Rhodesia.	1890. W. Australia Self-governing.
			1891. British Central Africa.	
			1893. Natal Self-governing.	1893. Solomon Islands.
		1894. Uganda.		
		1895. E. African Protectorate		
		1898. Wei-Hai-Wei.	1898. British Conquest of Soudan.	
			1900. Boer States annexed.	1900. Tonga Group.
20th Century.			1907. Transvaal and Orange River Colony made self governing.	1901. Australian Commonwealth.

CHAPTER III.

Climatic Provinces and Broad Geographical Units of Our Empire.

[Maps to be studied: Isothermal Map; Rainfall Map and Vegetation Map.]

THE table given as a supplement to Chapter I. suggested to the student the wide variety of climate (due primarily to wide distribution in latitude) to be found among the colonies of the British Empire. All the climatic types worked out in Chapter VIII. Part I. (*Physical Geography*), are to be met with in the Empire. Arctic, temperate and tropic climates are modified by physical structure, oceanic and atmospheric circulation, so as to afford examples in every zone of extreme and equable type of climate; so that we get—

Arctic-extreme and Arctic-equable
Temperate-extreme and temperate-equable } Types.
Tropic-extreme and tropic-equable

We cannot do better than compare the members of the Empire which fall within the same zone, as grouped in the table mentioned (*p.* 565).

(*a*) NORTH TEMPERATE ZONE.

The Dominion of Canada, almost continental in dimensions, offers many points both of comparison and contrast with the British Isles.

A negligible portion of its mainland falls within the **Arctic** Circle, but *Arctic conditions* prevail over half its surface, even as far south as the latitude of London, on the plateau of *Labrador*. This is clear to the student who traces the mean annual isotherm, 32° F. Arctic conditions of temperature (not of night and day) even penetrate in January as far south as *Toronto* and *New York*.

The student will at once see that our islands are greatly favoured in the matter of temperature, compared with the Dominion of Canada as a whole, and the eastern half in particular.

The *Pacific seaboard* of the Dominion is the only region which can be compared with Great Britain in the matter of temperature. *British Columbia* is somewhat warmer in summer and slightly colder in winter than our British islands, in the same latitudes. We say that our climate is more *equable* than that of British Columbia.

The map of mean annual ranges of temperature brings out the striking *contrast between the two sides* of the Rocky Mountain Cordillera. Whilst on the Pacific seaboard the range between summer and winter is so low as to be comparable with that of Great Britain, on the inner flank sloping away to the Hudson Bay depression, the range from summer heat to winter cold is so *extreme* as only to be surpassed by that of the Siberian interior. It will be noted that these two great extremes are associated with *continental* masses; here we have a partial clue to the cause of high ranges of temperature. The greater the continental mass the wider the range; indeed, climates characterised by wide range are called "continental" climates. But *North Africa* is a huge

continental mass (quite comparable with Canada in area, as the student will discover by examining a globe, and refusing to be misled by maps on Mercator's projection), and its range is only 30° F., whilst that of *Winnipeg* is 80° F. *Latitude* comes in as a factor; in reality the range is higher at Winnipeg than at *Khartum*, largely because Winnipeg has long summer days and short winter days, whilst the *Sudan* summer day differs little in length from the winter day.

A careful study of Canada and the British Isles brings out the following facts:—

British Columbia.	Canadian Interior.	St. Lawrence Valley.	British Isles.
Fairly equable. Average range 40° F.	Distinctly continental. Average range 80° F.	Fairly extreme. Average range 60° F.	Very equable. Average range 20° F.

This is well illustrated by considering the cases of *Vancouver*, *Winnipeg*, *Anticosti Island*, and *Winchester* (England), all in about the same latitude. In these cases *the latitude factor is eliminated.* The isothermal maps give results as below:—

	Vancouver.	Winnipeg.	Anticosti.	Winchester.
Summer t°	65° F.	68° F.	60° F.	63° F.
Winter t°...	32° F.	5° F.	10° F.	41° F.
Range ...	33° F.	63° F.	50° F.	22° F.

The contrast between Vancouver and Winnipeg is so much more marked than that between Anticosti and Winnipeg that nearness to the sea is not sufficient to explain it. The interposition of the *Rocky Mountain barrier* must be taken into account. No such prominent highlands shut off the interior plains from the St. Lawrence Gulf.

The *trend* of *oceanic circulation*, the direction of the prevalent *winds*, and the action of mountain-walls as *rain barriers*, have all to be taken into account to explain why climatic types vary so much, even in the same latitude.

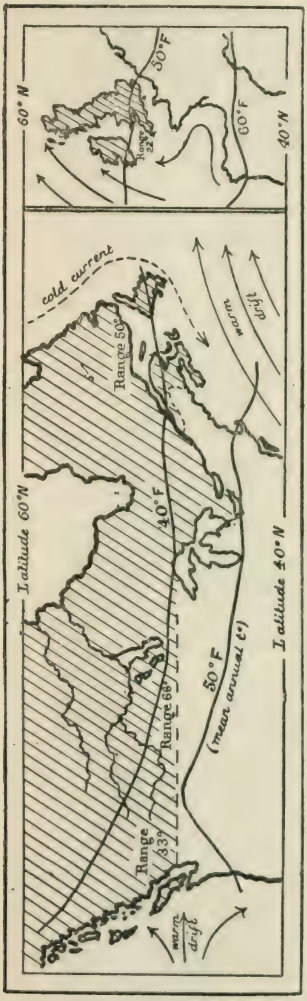


FIG. 298.—CLIMATIC COMPARISONS—CANADA AND GREAT BRITAIN.

The North Pacific drift reaches the shores of British Columbia from due west; it is the trans-oceanic continuation of that warm drift which includes the Japanese *Kuro Siwo current*. British Columbia, even more than California, benefits by it. The *west-wind-drift** in the Atlantic, on the other hand, is deflected westward in a latitude 10° nearer the Equator by the eastward bulging Canadian continental mass. The *Gulf of the St. Lawrence* reaps no advantage from this drift. (The British Isles, it may be noticed, receive the warm North Atlantic drift from the *south-west*, which fact explains why it is warmer than if it had traversed a belt of latitude from due west.) *British Columbia* is, therefore, more equable than *Anticosti*, partly owing to

* The North Atlantic Drift.

the tendency of oceanic drifts; for the same reason the *British Isles* enjoy a still more equable climate. But this is not all. *Rainfall* is a great equaliser of temperature conditions. The climate in rainy regions is never extreme or continental in type, but for any given belt of latitude (where days are approximately equal in length for the same season of the year) the equable character of the climate is, we might almost say, proportional to the rainfall. Condensation liberates heat, and predominates in winter rather than in summer. This *rain in winter tends to raise the temperature.* It is the *dry interior* that registers such low winter temperatures. In summer condensation takes place in the *upper layers* of the atmosphere, and tends to raise the temperature of those layers. Those layers are much cooler than the air at the earth's surface the falling rain is therefore cooler than the warm, lower layers of air. The effect is a cooling one upon the sultry

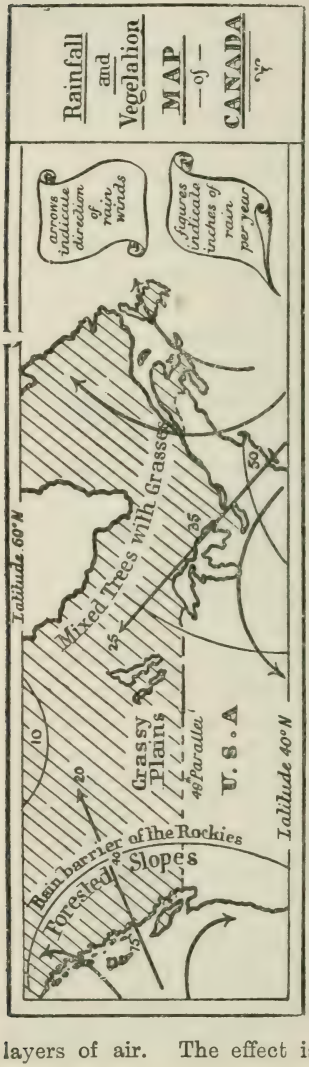


FIG. 299.—RAINFALL AND VEGETATION MAP OF CANADA.

air; evaporation is more rapid and extensive in summer, and *evaporation produces cold* by rendering heat latent. Still further, sea becomes less heated than land under the same amount of sun-heat.

It is clear then that *rainfall is an equaliser*, tending to reduce summer heat and to minimise winter cold.

The following table is instructive:—

	Rain.	Range.
Vancouver ...	75 ins.	33° F.
Winnipeg	20 ins.	63° F.
Anticosti	40 ins.	50° F.

There remains to be considered the *modifying effect of the Rocky Cordillera*. The rain-bearing winds coming in from the Pacific strike the western flanks of the ranges nearly normally; the inrushing, moist air is forced up into the upper and colder layers of the atmosphere. The range is so lofty (with its culminating ridges above snow line) that condensation commences, and is almost completed, before the wind has traversed the Cordillera. The cool wind, bereft of its moisture, blows down the long eastern flank of the Cordillera, and as it does so becomes warmed, and therefore even less liable to yield rain.

The seaward flank is thus very rainy, whilst the interior basin is shut out from the rain supply by the mountain-barrier. The dry interior forms what is known to geographers as a "rain-shadow" region.

Mountain ranges therefore play a part in determining the climate of the country in which they occur. Their effect is marked in proportion to their *altitude* and their *normality* to the in-blowing moist winds.

Latitude variations, giving different lengths of day and night, are thus not the only factors in determining climatic provinces.

Oceanic circulation and *winds* play an important part, whilst mountain masses modify the effects of winds, and largely determine the *distribution* of rainfall. In the absence of any highland barrier, the rainfall diminishes gradually towards the interior from the sea, whence the rain-winds come.

In **physical structure** Canada is divisible into three main divisions :—

1. The St. Lawrence valley.
2. The saucer-like interior, sloping from every side to the Hudson Bay depression.
3. The Pacific seaboard and flanks.

1. The first is easily divided into :—

(*a*) St. Lawrence valley and gulf.

(*b*) The lake plateau (Laurentian plateau).

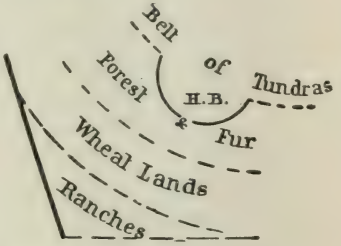
2. The second is continental in dimensions ; climate increases in severity from the S.-W. corner, *diagonally* towards the sea-passages west of Greenland ; the concentric belt zones are occupied by :—

(*a*) Tundras.

(*b*) Forests.

(*c*) Prairies.

(*d*) Ranching hill country.



PRODUCTIVE ZONES IN CANADA

3. The third forms a region of parallel ranges (the highest on the east) dropping down to the sea—a land of cascades and zig-zag valleys, *fiords* and sounds. The off-lying chain of islands may be considered the last and the lowest of the ranges, with zig-zag valleys converted into channels and straits.

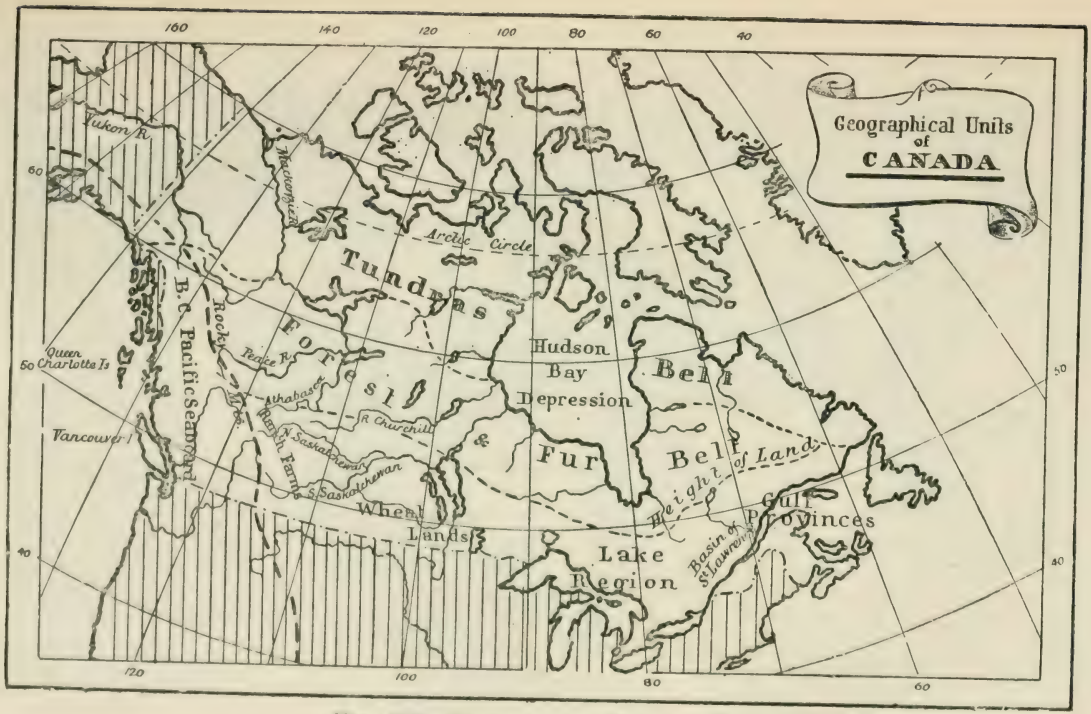


FIG. 300.—GEOGRAPHICAL UNITS OF CANADA.

These physical divisions are also climatic divisions, and it naturally follows that vegetation varies with climatic conditions. Each division may be described therefore as a *geographical unit*. By this we mean that each division has its own distinctive *individuality* of structure, climate, productions, and agricultural possibilities. Fig. 300 attempts such a classification of the geographical units of Canada.

From Fig. 301 the student will gather that one half of the *Dominion of Canada* is really Arctic in character, and therefore offers small possibilities of development; the southern belt, traversed along its warmer edge by the Canadian Pacific Railway, is almost entirely within the colder half of the North Temperate Zone, only the southern extremity of Nova Scotia and the lake-peninsula of Southern Ontario being nearer to the Equator than to the Pole.

The *Bermudas* and the *Bahamas* enjoy a tropical climate, though outside the astronomical limits, whilst Honduras, our West Indian Islands, and Guiana, fall within both the astronomical tropics and the geographically defined torrid belt.

The student is referred to Section II. (*The British Isles*) in this book for a study of climatic conditions and agricultural possibilities of the United Kingdom.

The islands of the *Mediterranean* are in a distinct climatic province, whose individuality is due to it being in reality a *land-locked ocean*.

The plains of *Lower Egypt* (under English protection) and the plains of *India* just escape the tropic and torrid limits set in Fig. 301. But *Upper Egypt* and the *Deccan* tableland of peninsular India, *West Africa*, *East Africa*, and our possessions in the *East Indies*, all fall within the torrid zone. The same is true of our *Central African territories*

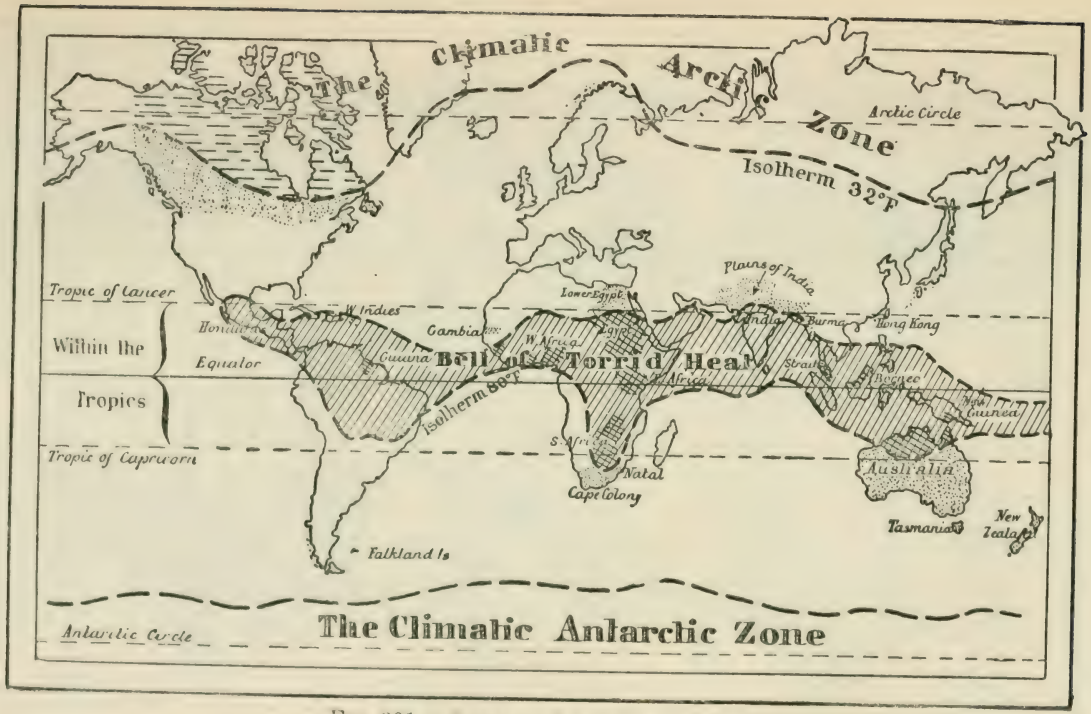


FIG. 301.—CLIMATIC BELTS OF THE WORLD.

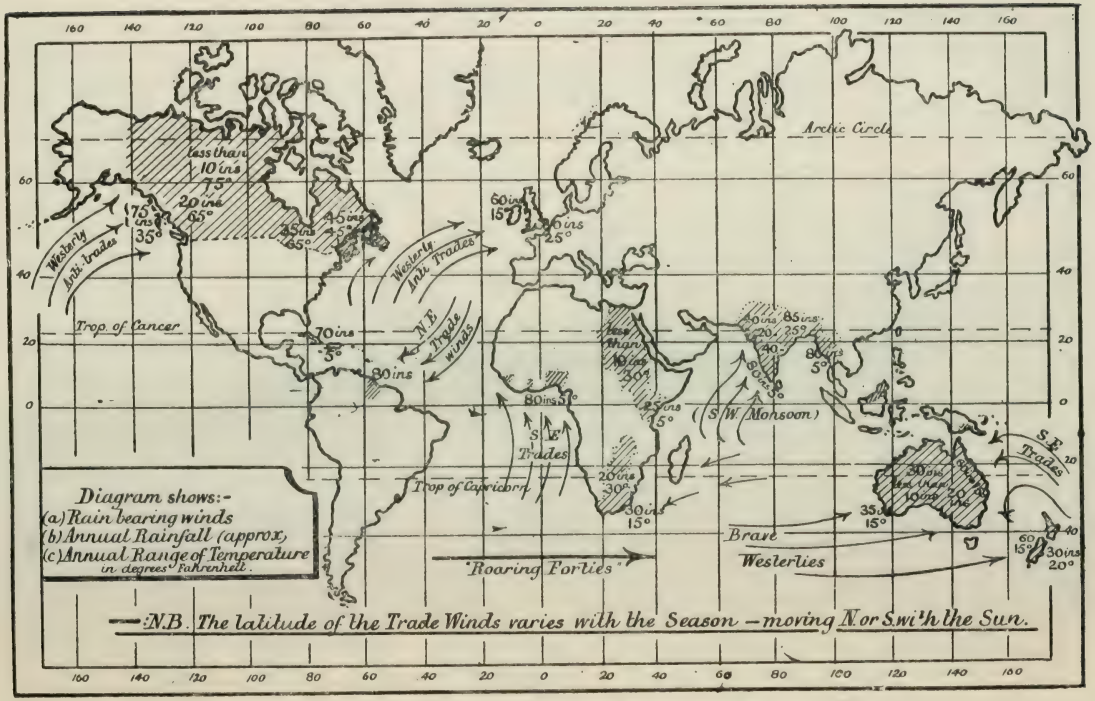


FIG. 302.—CLIMATIC CONDITIONS IN VARIOUS PARTS OF THE EMPIRE.

and *Rhodesia*, as well as of nearly the whole of the *northern half* of the *Australian continent*.

Neglecting Gibraltar, Malta and Cyprus, which receive attention in Chapter VIII., we will now notice the countries which lie around and within the tropics.

(*b*) POSSESSIONS WITHIN THE TROPICS.

At the Equator, days and nights are equal (twelve hours each) throughout the year. On either of the tropics the mid-summer day is about $13\frac{1}{4}$ hours long, and the mid-winter day, of course $(24-13\frac{1}{4})$, *i.e.*, about $10\frac{3}{4}$ hours long.

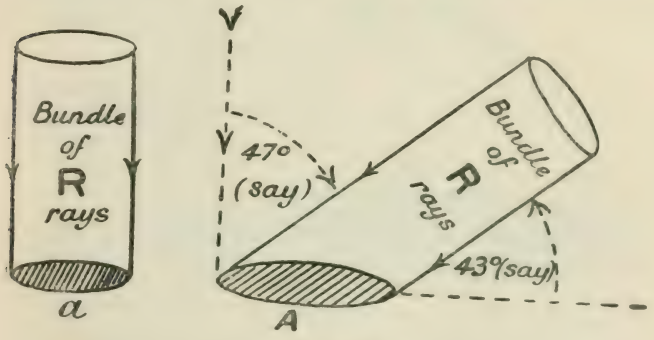


FIG. 303.

[Diagram to illustrate loss of heating-effect with obliquity of rays. The same number of rays (R) falls upon the same area (*a*) as upon the much larger area (A), hence (*a*) becomes much more heated per unit area than (A).]

These represent the *extreme limits of variation* for places within the tropics. Nearer the Equator they are less marked; beyond the tropics (*e.g.*, Lower Egypt, the Ganges, and Indus valleys, South Africa, Australia (south half), the variation is slightly greater.

Tropic countries, then, differ from Canada in having average days rather than very long, summer days, and very short, winter days. This, of course, *tends to equalise the temperature throughout the year.* Thirty degrees Fahrenheit

33° F. is considered characteristic of an equable climate in the cold temperate zone (*e.g.*, Vancouver), where ranges rise to the extreme of 80° F. (Hudson Bay) and 100° F. (Siberia) in high latitudes.

The extremes will tend to occur on the outer edge of the tropic belt, where days vary more than at the Equator.

The regions of **Cancer** and the regions of **Capricorn** have a maximum difference of altitude of summer and winter suns. On the *mid-summer day* in each case the sun is overhead, on the *mid-winter day* the sun is 47° (*i.e.*, $23\frac{1}{2}° \times 2$=latitude.

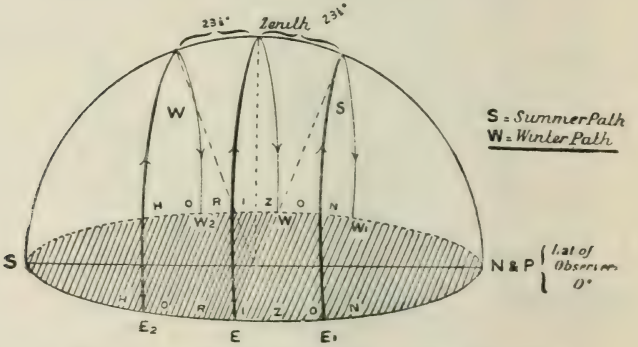


FIG. 304.—CASE OF OBSERVER AT THE EQUATOR.

E_1W_1=path of sun across the sky on June 21st.
E W = ,, ,, ,, Sept. 23rd and March 21st.
E_2W_2= ,, ,, ,, December 22nd.

Note similarity for *June* and *December* (S. and W.).

distance the tropics are apart) away from the zenith, and therefore (90°−47°), *i.e.*, only 43° above the horizon.

For the **Equator,** however, the sun is never more than $23\frac{1}{2}°$ from the zenith, whether in December or June, and so small an angle from the vertical makes far less difference (see Fig. 303) in proportion of heating power than for a distance of 47° from the zenith. Moreover, in January and July the

altitude is the same in both cases, viz., *about* 23½° from the vertical; it is in March and September that the sun is overhead.

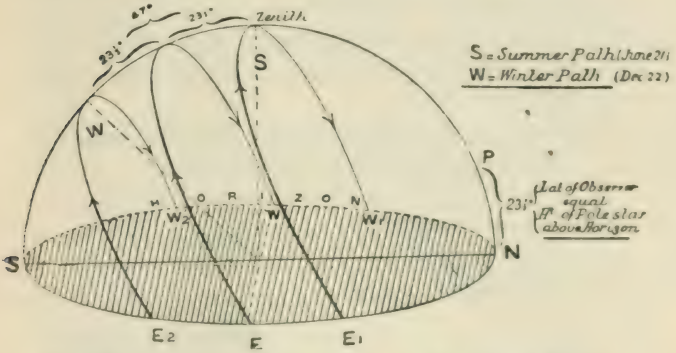


Fig. 305.—Case of Observer at the Tropic of Cancer.

E_1W_1 = path of sun across the sky on June 21st.
E W = " " " Sept. 23rd and March 21st.
E_2W_2 = " " " December 22nd.

Note *dissimilarity* for *June* and *December* (S. and W.).

[The student should draw the diagram for the *Tropic of Capricorn*.]

Comparing the Tropic Lines with the Equator we get:—

Cancer and Capricorn.	Equator.
1. Days vary considerably in length between summer and winter.	1. Days do not vary in length.
2. Obliquity of rays varies as much as 47° between summer and winter.	2. Obliquity of rays varies only 2½°.

The student has only to *compare rainfall and annual rain* maps to find again that rainfall is an equalising factor; the extremes are associated with the dry regions; the equable regions are those of heavy rains; latitude and rainfall play their part, then, in tropical climatic determination, as well as in extra-tropical countries.

Mountain barriers also act as rain-barriers, though not so markedly, since the upper layers of the atmosphere are warmer than in high latitudes; against this fact, however, we must consider the greater evaporation going on under tropic suns, so that the rain-winds are bearing heavier loads of moisture.

The most important *rain-barriers* to be noted in our tropical possessions are:—

(*a*) The Central American range behind Honduras.

(*b*) The Kong Plateau-ridge in West Africa.

(*c*) The Western Ghats in S. India (*see* Fig. 306).

And most pronounced of all

(*d*) The Himalayas (*see* Fig. 306).

(*e*) The ranges of Burma.

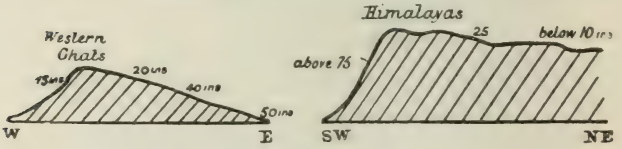


FIG. 306.—RAIN-BARRIERS IN INDIA.
(*Figures represent annual rainfall.*)

Low *islands* near the Equator supply all the conditions for a low range of temperature. Next to these come *shore-lines* in equatorial latitudes.

Guiana, our *West African possessions*, *Southern India*, *Ceylon*, and our settlements in the *East Indies*, have all not more than 5° F. annual range of temperature. *Honduras*, the *West Indian Islands*, *Uganda*, *East Africa* and *Burma*, more remote from the Equator, have a range up to 10°. The range is greatest on the plains of *Egypt* and *India* beyond the Tropic Line. Thus, for tropic lands, **5° F.** represents an extreme type of mean annual range.

The West Indian Group includes the large island of *Jamaica*. the smaller islands of the Antillean chain (*Barbados* and *St. Vincent* are the most important), and *Trinidad*, an

off-lying island of the South American continent. *British Honduras* is a strip of the shore-land of the Caribbean depression, shut off from Pacific influences by the long wall of the Central American Cordillera. *British Guiana* is a similar but broader strip between the Guiana highland and the open Atlantic, and receives the full sweep of the Equatorial Current.

Jamaica is a mountain wall, and its two flanks present some contrast in climate, the southern being warmer. At the same time it is broader and more fertile. The range of temperature is slightly more than that of the islets of the *Antilles*, which show an average of 6° F. *British Guiana* is nearest the Equator, has the highest mean annual temperature and the least range.

The West African Colonies form another convenient group along the seaboard from the Gambia River to the Lower Niger country. Apart from the Gambia valley, they occupy strips of coastland of various dimensions on the rainy side of the Kong ridge rain-barrier.

Where the ridge disappears, and the mighty Niger escapes from the continental interior, the river highway and easy possibilities of access have led to a greater development, so that *Nigeria* has three times the area of all the other West African colonies, and penetrates to the desert fringe of the Sahara. The average latitude is only 8° N.; days therefore vary little in length. *Rainfall* is very considerable, and is increased by the mountain frontier. As the student will expect, temperature is high and its range small; the mean annual isotherm is 82° F., the range is less than 5° F.

In striking contrast to this group (as also to the West Indian group) are the climatic conditions of **Lower Egypt**, the **Sûdan**, and the **East African plateaux.** Only **Uganda** and the region around the Nile sources have much rain. *Lower Egypt* is nearly rainless; it also lies farthest from the Equator, and therefore experiences the greatest variation in length

between summer and winter days. The *Súdan* is an upland basin, with some rain; *East Africa* and *Somaliland* are hot, dry plateaux, the former bisected by the Equator.

If anything, Uganda, East Africa and Somaliland are *hotter* than West Africa or Guiana. Hot and dry, they are less fertile. *Uganda* is most productive, especially around the shores of Victoria Nyanza. *Lower Egypt*, deprived of rain, with considerable variation in length of day, formed of a chalky basin, is naturally the most arid of this group of possessions. Strictly speaking, it is not a possession, but under the suzerainty of Turkey, and enjoys British protection. The fertile strip of the Nile valley owes its fertility to *floods*, and not to local rainfall.

South of the Equator, and extending along the African tableland from Lat. 80° S. to the Limpopo River and the Kalahari desert, in the region of the Tropic of Capricorn, are the *tablelands of the Zambesi* and its affluents.

Nearest the Equator and encircled by lakes are the territories of *North-East Rhodesia* and *British Central Africa* (Nyassaland). *North-West Rhodesia* is the old Marotse country, north of the main stream; *South Rhodesia* includes the hill country of the Matabele. Even the *Transvaal* projects within the tropics. The *Makarikari Salt-basin* and the *Kalahari Desert* suffer tropical heat in the absence of rain. *Range of temperature* increases as we travel southward along the plateau from Lake Tanganyika to the Kalahari Desert: *rainfall* (nowhere heavy) decreases nearly in the same direction; *variation in length of day* becomes more and more marked as we push southward. These facts explain the increase of range. The range is greater on the tropic of Capricorn than anywhere else in our British tropical possessions.

India, Burma and Ceylon form our next group. The continental mass of *India* easily falls into three natural divisions; the *Indus Basin* and the *Ganges Valley* (separated by the dry upland Desert of Thar) and the strikingly contrasted

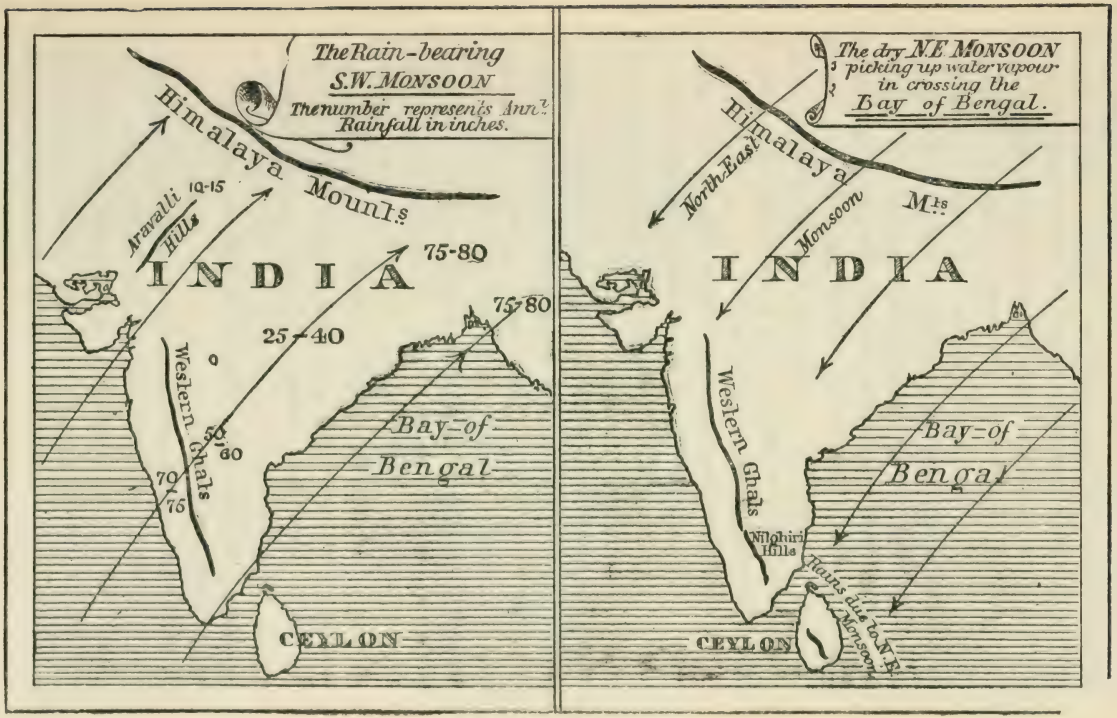


FIG. 307.—MONSOONS.

ancient plateau-block of the *Deccan*. Insular *Ceylon* affords some contrasts to the peninsular Deccan. The ranges of *Burma*, similarly placed in regard to the monsoons as the Western Ghats, offer points of comparison. The deltaic lands of the Irawadi have many features in common with the alluvial plains of the lower Indus and the province of Bengal. For their latitude the plains of India are the hottest region in the world, not excepting the Mexican tableland which, standing higher, should be cooler; the sheltering effect of the Himalayan wall on the north may account for this in part. Especially characteristic of this group of possessions is the "*monsoon*" *type of climate*. The origin of the monsoons is fully discussed in Chapter VI. of Section I.

The *south-west monsoon*, which brings heavy rains, blows in July and August, when the barometer is low over the Himalayas and the plateau of Tibet; the *north-east monsoon*, dry after its journey over a continent, sets in at the end of January, when the conditions of low pressure occur over the southern tropic zone. Air-flow at the surface of the earth is from high pressure areas to low pressure areas. Low pressure areas are roughly coincident with areas of maximum heat. (Compare the draught along the floor of a room from the cold doorway to the warm hearthstone.) "Mausim," from which the word monsoon is derived, is an Arabic word meaning "season." The sun is over the northern tropic at one season (midsummer) and over the southern at another (midwinter). The arrangement of Continent and Ocean on opposite sides of the heat belt gives the condition for monsoons. Land is much more susceptible to influences of heat and cold than water is.

The *Western Ghats* and, more markedly, the *Himalayas*, act as *rain-barriers* to the south-west monsoon.

The *Thar region* is low and insufficient to cause condensation; thus, though traversed by winds heavily laden with aqueous vapour, it remains a desert. Annual range of

temperature increases as we travel from the Equator. It is less than 5° F. in *Southern India* and *Ceylon*, where latitude is low, rainfall is heavy, and days are most nearly equal. It is more than 30° F. on the great plains which lie beyond the tropic limit. *Burma*, like the Western Ghats, has very equable climatic conditions. The *Ganges basin* resembles the Ghats and Burma in having heavy rains. The *Indus plain* is drier, and has therefore different agricultural possibilities. Taking the mean annual temperature, we may say that this group of possessions falls almost entirely within the geographically torrid belt.

The remaining tropical group consists (if we postpone the consideration of North Australia until we compare South Africa and the Australian continent in another section) of the scattered **settlements of the East Indies and the Far East.** It is worthy of note that they lie much nearer the Equator than do the West Indies. In other respects their climatic features reproduce those of the West Indies. Low range, torrid heat, heavy rains characterise the settlements on the *Malay Peninsula* and the island of *Borneo*. *Singapore* is practically on the Equator. *Hong Kong* is near the Tropic of Cancer, and therefore differs in climate. West Africa groups naturally with the West Indian colonies. The African plateaux, from Cancer to Capricorn, offer another type. The monsoon countries of India, Burma and Ceylon form a third distinct type. The Equatorial group of settlements in the East Indies recalls their namesakes of the West.

(*c*) SOUTH TEMPERATE ZONE.

Beyond the Southern Tropic are **South Africa** and the **southern half of Australia** in the warm temperate belt. **North Island** (*N. Z.*) has an average latitude of 38° S.; **South Island** (or Middle Island) extends 2° beyond the 45° S. co-ordinate. The *Falkland* group is the most southern outpost of the British Empire, if we neglect the polar wastes.

Yet it is only in the same latitude south that London is north; icebergs drift to its shores and seals sport on its rocks.

New Zealand should (historically) be grouped with Australia. Geographically this is not so clearly the case. *Twelve hundred miles of sea* separate them. New Zealand is, on the average, in much higher latitudes. Physically it is a *mountain wall* with no interior basin of any dimensions; on the other hand, *Australia* is a huge *saucer-like depression*

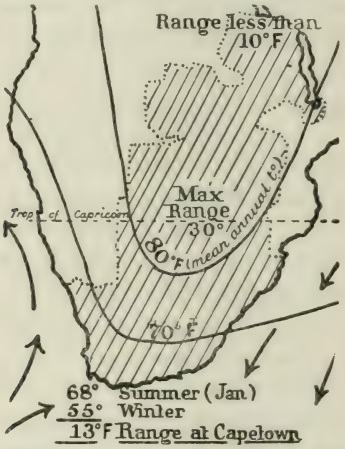


FIG. 308.—TEMPERATURE CONDITIONS IN SOUTH AFRICA.

with a mountainous eastern rim and a western plateau of considerable size.

Australia is best compared with *South Africa* from the geographical standpoint. Figures 308-313 will bring out the striking similarities in the physical geography of the two regions. If we include Rhodesia with South Africa, we first notice that the *tropic of Capricorn bisects both countries;* tropical conditions occur north of the line, sub-tropical to warm temperate conditions obtain south of the line. The range in latitude is very similar. Any variation in climate is due to the *disposition of the highlands* and the circulation of oceanic waters.

South Africa is elongated in a north and south direction; Australia has its major axis east and west, and coincident with the tropic of Capricorn. *South Africa* has its plateau and highlands contiguous on the eastern rim and its basin on the west opening toward the Atlantic. *Australia* has its plateaux in the western half, its basin in the eastern interior, and its mountain-rim on the east.

The *mean annual isotherms* of the two countries are the same, the most characteristic being 80° F and 70° F. (The isotherm for London is 50° F).

The form of the isotherm is determined by the shape of the continent. *South Africa* is a southern projection of an

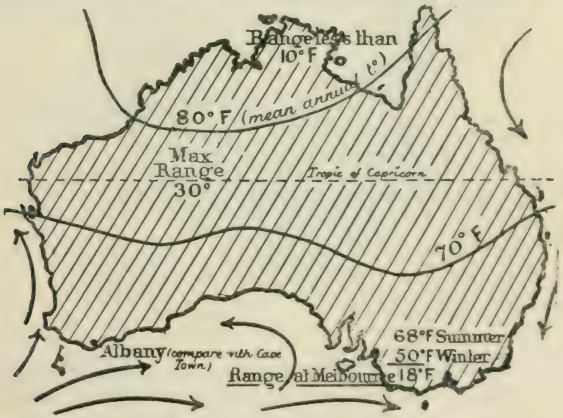


FIG. 309.—TEMPERATURE CONDITIONS IN AUSTRALIA.

essentially tropical continent. Line 80 F. marks a tongue of tropical heat projecting beyond the tropic frontier.

If we compare the annual range of temperature we find still further similarities; 10° F. and less near the equator; 30°F. as a maximum on the dry interior. The low range of 13° F. at *Cape Town* and that of 18° F. at *Melbourne* are due to oceanic influences. Cape Town is better placed than Melbourne for receiving warm oceanic drifts, and, as a result,

has a lower range. The southern extremity of *West Australia* should really be compared with *Cape Town* (mean annual temperature 60° F., range 13° F.).

Turning to the rainfall map, we find the analogy modified in the same way by the *trend of the land mass*. The concentric zones of rainfall have their long axes coincident with those of the countries; otherwise they offer striking similarities.

The *desert* is more fully developed in Australia than in South Africa, because the larger continent gives greater oppor-

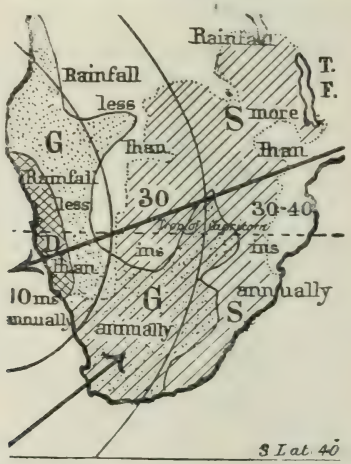


FIG. 310.—RAINFALL AND VEGETATION IN SOUTH AFRICA.
D=Desert. G=Grasslands. S=Savannah or Parklike Country.
Arrows indicate inflow of rain winds.

tunity, and also because there are *plateaux* on the west of Australia, but none worth comparing with them on the west of South Africa. The principal rain-bearing winds strike inward from the north-east, coming from a tropic ocean; they are warm and heavily laden. The Cape, the Australian Cape Leeuwin, and the promontories of South Australia receive rain from the cooler south and west. Tropical shore lands, backed by highlands, receive the heaviest rains.

Figs. 312 and 313 attempt to divide South Africa and Australia into their *geographical units* or *natural regions*.

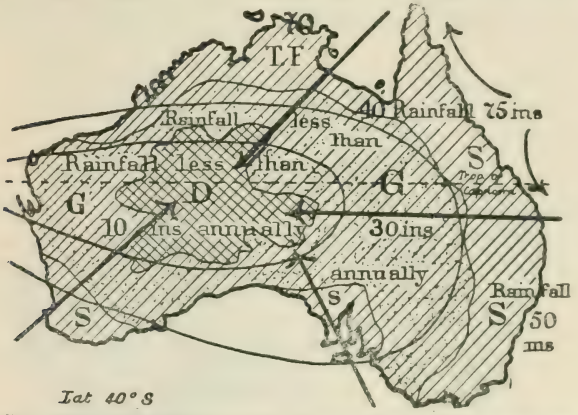


FIG. 311.—RAINFALL AND VEGETATION IN AUSTRALIA.
(D, G, and S as in Fig. 310). Arrows indicate inflow of rain winds.

The *Zambesi tableland* offers comparisons with the tropical shorelands of *North Australia*, but also some contrasts, in being drier, and as a result less equable and less productive. The *eastern coast belts* of the two countries show many resemblances, and even geologically are similar in structure. The dry tableland of the *Veld* may be compared with the sheep-lands of the *eastern interior*, and the *Orange basin* with the *Darling - Murray country*. Being a *tableland*, it will naturally offer some points of contrast with the Australian basin. South Africa has its *Makarikari salt basin*; Australia

FIG. 312.—GEOGRAPHICAL UNITS OF SOUTH AFRICA.

has the larger depression occupied, by the *salt lakes of Eyre, Torrens* and *Gairdner*.

The *Kalahari region*, passing from low bush through grass to scrub, is a miniature of the enormous expanse of

FIG. 313.—GEOGRAPHICAL UNITS OF AUSTRALIA.

scrub and desert on the western half of the Australian continent. Each has its redeeming feature. In Australia gold is found; in the South African desert belt, copper ores are mined.

Tasmania, being an island, is more subject to oceanic influences than any part of the compact continent of Australia. Its average temperature is that of France and Japan.

North Island presents a strong contrast to *South* (or Middle) *Island* in physical structure. The south-eastern corner of the island is really a low continuation of the high mountain backbone of South (or Middle) Island. The rest of the island is a region of recent *volcanic* activity, the last signs of which have not yet died out. *Hot springs, sinter terraces* and *sulphur deposits* are characteristic features of such a region. The whole island may not, unnaturally, be compared with the unsettled *Calabrian Peninsula of Southern Italy* in its form (a Wellington boot), its volcanic character and its latitude.

South (or Middle) *Island* affords another example of a "rain-barrier," though the extremes are not so marked on an island as on a continent.

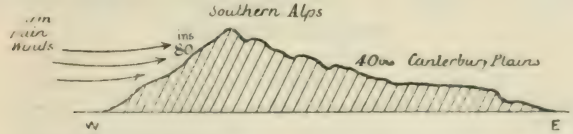


FIG. 314.—THE RAIN-BARRIER OF SOUTH ISLAND, NEW ZEALAND.

The steep slope of the *Alps* facing the rain-winds from the north-west is a forested region (Kauri pine). The drier flank occupied by the *Canterbury plains* and their extension along the seaboard supports forests and sheep-farms.

Stewart Island is an outlier of the larger island.

The Falkland group has many sheep-farms.

The student should study the following table:—

		SUMMER RAINFALL.	WINTER RAINFALL.
	Cold Temperate Zone:		
A.	British Columbia ...	Medium.	Very heavy.
	Canadian Interior ...	Light.	Medium.
	St. Lawrence Basin	Medium.	Heavy.
	British Islands... ...	Medium.	Very heavy.
	Warm Temperate Zone:		
B.	South Africa ...	Heavy.	Light.
	Southern Australia...	Light.	Heavy.
	New Zealand	Medium.	Heavy.
	Tropic Belt:		
C.	West Indies	Very heavy.	Heavy.
	West Africa	Very heavy.	Medium.
	Central Africa	Very heavy.	Light.
	India	Very heavy.	Light.
	Northern Australia...	Very heavy.	Light.

A. In Cold Temperate Zone, the belt of cyclonic weather, rainfall is scarcely seasonal, being distributed over the year, but heaviest in winter.

B. In Warm Temperate Regions rainfall varies chiefly with the distribution of the land and water masses, which have differing specific heats.

C. In the Tropics summer rains are exceptionally heavy.

The seasonal feature in rainfall is most strongly developed in Monsoon countries.

TABULAR VIEW OF GEOGRAPHICAL UNITS OF THE BRITISH EMPIRE.

	Equable.*	Intermediate Types.		Extreme.*
Arctic.		The Yukon Basin.	The Mackenzie Basin. The Hudson Bay Depression.	The Arctic Islands.
N. Temperate.	The British Isles. British Columbia.	The St. Lawrence Valley.	The Plateau of the Great Lakes.	The Wheat-lands of the Interior.
	The Gangetic Plain.	Western Mediterranean.	Cyprus. The Indus Basin.	Egypt (Prot.).
Tropic.	The Guinea Coastlands. East Indian Archipelago (Settlements). The Australian Shorelands.	The Deccan. Burma. Queensland Coast Belt.	Eastern Soudan. Central African Lake Colonies. The Zambesi Tableland.	Somaliland. Kalahari and Ngami Region. W. Australian Interior.
S. Temperate.	Tasmania.	Natal. E. Australian Coast Belt. W. Australia (S.W. Corner). S. Australia. North Island, N.Z. South Island, N.Z. Falkland Is.	Cape Colony. The Darling Murray Basin.	The Veld. Lake Basin of S. Australia.
Ant-Arctic.				

[* The student will have noted the remarks about the comparative use of these terms; 80° F. range being extreme for high latitudes, 30° F. for the tropics.]

CHAPTER IV.

Further Consideration of the Geographical Units of the Empire; more especially in relation to their Resources and Possibilities of Development.

THE table given at the end of Chapter III. will serve as a useful introduction to the survey to be taken in this chapter. We propose to consider the different geographical units again under the three groups—

(*a*) Arctic types,
(*b*) Temperate types,
(*c*) Tropical types.

(*a*) **ARCTIC TYPES.**—If we neglect the few unpeopled islands beyond the Antarctic Circle, the geographical regions of the British Empire, which experience an Arctic climate, are all to be found in the *North Frigid Belt*, and then only in the *New World*.

The Yukon Basin opens out westward to the *Behring Sea*. It lies, on the whole, just south of the Arctic Circle. Only the gathering ground of the convergent headstreams is within British territory. The average annual temperature is 10° F. below freezing point of water. But summers are considerably warm, the *July Isotherm* being the same as that of the *British Isles*. It is the winter that is so severe, registering nearly 50° F. of frost on an average in January. The great difference between the length of summer and of winter days accounts for

its climate not being *equable* when winds and ocean drifts would tend to make it so. Comparatively speaking, it is more equable than any other arctic unit on the North American Continent, although its mean annual range is 70° F. The flats on the river banks are fertile, and support grass; the sources of the streams touch the forested uplands. *Gold* is the great attraction to the colonist. *Placer-gold* in the alluvium and *reef-gold* in the hills are worked. *Fur-trading* forms a minor industry. *Dawson City* is the commercial focus and *Dyea* the outlet port.

The Mackenzie Basin looks northward, and its delta opens out toward the ice of the Arctic Seas. Although the river course is interrupted by a chain of lakes (*Athabasca*, *Great Slave* and *Great Bear*), the region is one of *low rainfall*. The streams obtain their perennial supply from the snows of the *Rocky Mountains*. The upper basin, to the south, has a grassy covering, and even coniferous trees; *trapping* is practically the only industry. *Gold* has been discovered along the Laird River; ores of the precious metals are not, however, specially associated with the Secondary Rocks which occupy the belt between the Rockies and the lake-chain. Petroleum is worked in the older rocks around the Great Slave Lake. *Low rainfall* (the basin is on the rain-shadow side of the Rocky Mountains) and *high latitude* combine to give *wide range of temperature* between summer and winter. The range is a maximum along the middle section of the river-course:—

Summer isotherm	62° F.
Winter „ (dry and cold) ...	−20° F.
Range	82° F.

The dreary *tundra* so characteristic of Arctic shore-lands is found all over the lower basin; it is soil saturated with water, forming a sticky mass under the summer sun, and a hard, stony floor under the keen frosts of winter.

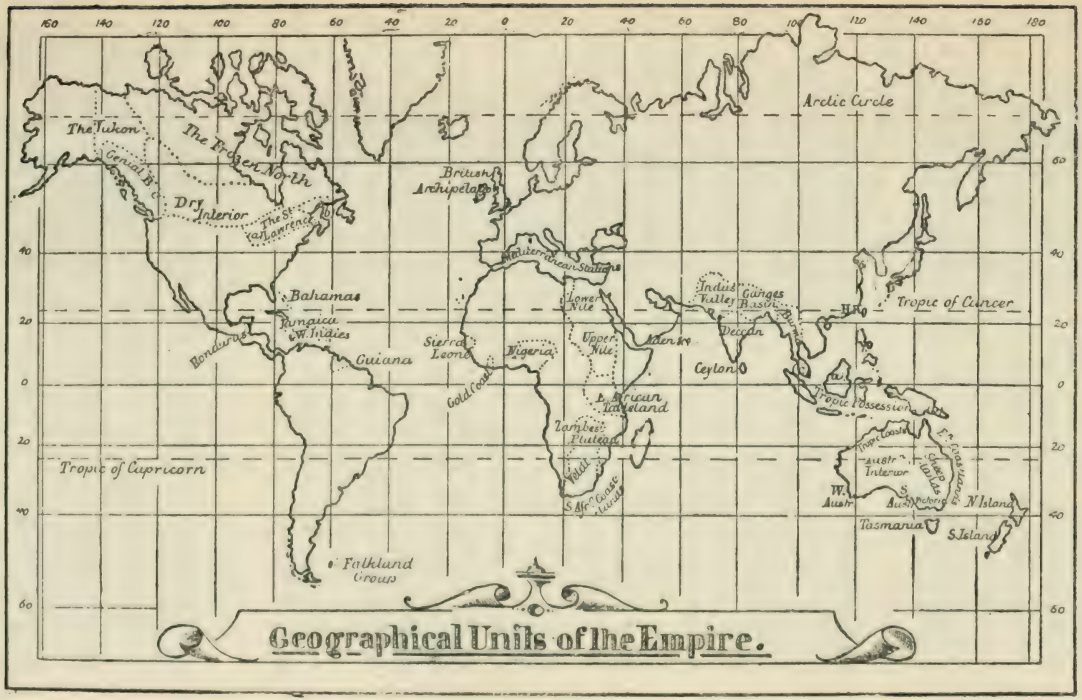


FIG. 315.—GEOGRAPHICAL UNITS OF THE BRITISH EMPIRE.

The Hudson Bay Depression belongs in climate to the Mackenzie type. The bay is of such huge dimensions that its southern half projects as far south as the *latitude of London.* It is the *gates* of the bay that are Arctic in type, though in winter the temperature anywhere in the bay is as cold as *Archangel.* The *geology* of the basin is quite different from that of the upper Mackenzie region, and, indeed, from any other region on the continent. Here we have the primeval floor of crystalline rocks, elsewhere covered by sediments, exposed along the ring of coast-land within the semicircular lake-chain, the trend of which runs in striking parallelism to the coast-line. Rivers drain radially towards the bay, the *Churchill* and its lake system contribute water from the west, and mark the northern limit of agriculture as yet. *Labrador* sends steamers from its bleak, barren plateau on the east. The more genial lands of the south and south-west of the Canadian interior send their quota by the *Saskatchewan* and its group of streams and lakes. Some *timber* is available, especially on the southern shores of the bay; *trappers* are the only traders of the Arctic belt. Ice prevents the bay ever becoming the outlet of the *wheat-lands* and ranch-farms of the interior. Forts *Churchill* and *Nelson* (York) at the mouths of the rivers are the inevitable gates of trade on the Hudson Bay. Trappers make southward to *Winnipeg*, on the C.P.R. line of communication.

Arctic Islands.—More Arctic than any part of the mainland are the islands which lie ice-clad beyond the *North West Passage.* *Baffin Land* blocks the mouth of the Hudson Bay.

[The continental mass of *Greenland* stretches from polar latitudes to 60° N., the latitude of the Shetlands, and forms the major mass of the ridge, partially submerged, which links America through Iceland with Scandinavia in Europe. Greenland is the most habitable of these islands, but even it is only

peopled along the southern shore. The tableland which fills the interior is covered with ice and *névé* (or *firn*) except that bare pinnacles of rock (*nunataks*) jut out through the ice. Whale and seal fisheries are the only available employment of the men-folk. Greenland, like Iceland, owns Danish sovereignty, and its inhabitants are descendants of Norse sailors.]

(*b*) **GEOGRAPHICAL UNITS WITHIN THE TEMPERATE ZONES.**—The student will, in the first place, observe that *land predominates over water in the north temperate zone*; in the south temperate zone the reverse is the case. We have already remarked that land, having a *low specific heat*, is more susceptible to changes of temperature than water; as a result, it affords *greater ranges of temperature* between summer and winter than do oceans and oceanic islands. On the whole, then, countries in the north temperate zone are more "extreme" or continental in climatic type than those in the corresponding southern zone. Again, the student will note that our British possessions in the north temperate zone fall mainly within the *colder half* of that zone, *i.e.*, north of lat. 45° N., whilst those of the south temperate zone lie chiefly in the *warmer half* of that belt. In the warmer half of each zone the days are more equal in length all the year round, which fact further accounts for the more equable character of our southern possessions. *Rainfall-distribution* is the principal element which enters to disturb the effects of the above factors.

1. Units of the Empire in the North Temperate Zone.

[The order followed is from west to east along the belt.]

British Columbia occupies the *Pacific seaboard* of the Canadian Dominion, and stretches back to the culminating ridge of the *Rocky Cordillera* overlooking the interior plane. It also includes the off-lying mountainous archipelago-chain

of *Vancouver Island* and the *Queen Charlotte group*. The whole region is a series of parallel mountain ranges of descending height towards the west, with the *island-chain* as the submerged outermost range. The *intermont valleys* communicate by gaps in the ranges, and so give rise to *zig-zag rivers*, escaping from valley to valley till they reach the "drowned valley" of Queen Charlotte Sound. *Cascades* are natural in such a country, and the name of the coast range is derived from their presence. *Rainfall* is here by far the heaviest in the Dominion, and climate is most nearly of the equable type. *Timber forests* clothe the rainy slopes, and form a valuable asset. The *Douglas fir* is the finest of the trees. *Gold* is a characteristic export from the inner ranges. The more southerly ranges have been largely worked, and prospectors are now turning to the *copper ores*, which abound. Lead and silver, zinc and platinum are also mined.

Northward the gold reefs and deposits are still largely unworked. The rivers (Fraser, Columbia, etc.) are rich in *salmon* in their lower courses. *Seals*, of the variety which yield the best sealskin, are found north of the Queen Charlotte group. *Coal* is plentiful on the inner slopes of the island-chain. *Vancouver* on the mainland, the terminus of the C.P.R., and *Prince Rupert*, the prospective terminus of a new cross-continental line—the Grand Trunk Pacific Railway—are the natural outlets of British Columbian industry. The former finds outlet by the *Straits of Juan de Fuca* and the latter by the deep sound known as *Dixon Entrance*.

The Wheatlands and Ranching Country of the Canadian Interior present many striking contrasts to genial, moist, mountainous Columbia. The ranch-lands are mere foot-hills; the wheatlands are rolling plains. The whole region, cut off from the Pacific by the Rocky Mountain wall, is a *rain shadow area*, rainfall being only one third of that on the seaboard. Summers are hotter and winters very much colder and drier

Rivers (the Saskatchewan and its affluents) are more sluggish. Trees are scarce; *grasslands* predominate. The foothills are the region of *ranch-farms*.

Horses are the principal livestock. *Wheat* is so profitably grown on the prairie lands that the plain of the interior has become "the granary of the Empire." Towns have sprung up along the southern frontier and the track of the Canadian Pacific Railway. Lateral branches have been thrown off to the north in both the wheat and ranching districts. The new trunk line is destined to cross the country in a higher latitude than the C.P.R., but parallel to it, and the lateral branches mentioned will serve to link the two systems. *Calgary* is the rancher's capital. *Regina* is the centre of the richest wheat-lands. *Winnipeg* is the great emporium of the interior. It is from these centres that the lateral lines push northward. The great lakes of Canada and the navigable St. Lawrence form a water-outlet of trade.

The Plateau of the Great Lakes belongs partly to Canada and partly to the United States. The northern shores from *Port Arthur* to *Kingston* are in the possession of Canada. Only Lake Michigan has no shorelands belonging to Canada. The plateau presents steep walls to Lakes Superior and Huron, and rises gradually to the watershed or "*Height of Land*" midway between the lakes and James Bay.

The whole Canadian region is included in the province of *Ontario*. It is easily divisible into two distinct portions. The larger and higher *plateau* north of the Canadian Pacific Railway is as yet largely undeveloped; the smaller and *lower region* lies south of that railway and the river Ottawa, and thrusts itself in among the lakes till its southern extremity is in the *latitude of Rome*. This latter region is the most thickly peopled in the whole of the Dominion. Railway, canal and lake traffic are here fully developed. *Forests* occur on the bleaker upland plateau, and lumbering, with its accessory industry of pulp-making, forms part of the prosperity of the

plateau; *fruit farms* are very profitable on the warmer southern plateau, where agriculture is well advanced. The colder plateau north of the lakes has a future before it as the richest region for *nickel ores* in the Empire. These are associated* with *copper ores* (as is generally the case with nickel deposits); *iron ores* of good quality also occur, and *silver* is found native. It is as a rich, mining region that the lake plateau is like to develop. *Sudbury* on the C.P.R., and *Sault St. Marie* on the canalised water highway are the likely foci of the smelting industries. *Toronto* and *Hamilton*, both below the *Niagara Falls*, are the centres of industry on the thickly peopled peninsula, where English predominate considerably over French. They are joined by rail with *Owen Sound*, on the *Georgian Bay* of *Lake Huron*. It is proposed to make a ship canal along this route, and so avoid the circuitous route viâ Lakes *Huron* and *Erie*.

The St. Lawrence Valley is a long, narrow, ancient trough opening out to the cold north-east in a gulf which is blocked by ice for four months in the year. To the north is the crystalline plateau, heavily forested towards the St. Lawrence; to the south are the folded ranges of the *Appalachian system*, the innermost of which terminates in the *Gaspé peninsula*. The only tributaries of any importance are the *Ottawa*, which serves as a provincial frontier, and the *Saguenay*, with its fine, deep estuary—an arm of the St. Lawrence estuary. Below the lakes, and especially from Montreal to the sea, French outnumber English. The meadows of the valley support rich *dairy farms*. The forests of the slopes afford *timber* and *wood-pulp*, the shallow gulf has valuable *cod*, *lobster*, and *herring fisheries*. The gulf-province of *New Brunswick* and the island of *Cape Breton* have *coal*. *Newfoundland* blocks the entrance to the gulf; it forms a detached portion of the Appalachian ranges. The climate of the St. Lawrence valley

* One mining village is named **Coniagas**, from *co*=cobalt, *ni*=nickel, *ag*=silver, *as*=arsenic.

recalls that of *Sweden*, although its latitude is that of *France*. *Montreal* is the largest town in the Dominion; it is remarkably well placed for a traffic-centre. The C.P.R. and G.T.R. have their *termini* in Montreal. The *St. Lawrence highway* and the *Champlain depression* (leading to the Hudson valley and New York) converge upon it. *Quebec* is the metropolis of the French Canadians, and, as the proposed base of the new cross-continental route to *Prince Rupert*, may have an era of even greater prosperity to come. *Halifax* in Nova Scotia is the port most used when the St. Lawrence is ice-bound. *St. John's* is the capital of Newfoundland and the Canadian terminus of many Atlantic cables.

The British Isles *correspond in latitude to the southern half of Hudson Bay* and the bleak plateau of *Labrador*, to which they afford a striking contrast. They form the only considerable *archipelago* off the European coast, rising from a broad *continental shelf*, whose seas are the home of valuable *fisheries*. The climate is the most *equable* of all the countries in this belt of latitude. *Rainfall* is considerable along the western coasts, which happen to be the oldest and most mountainous. The lower eastern regions are drier, forming a "rain-shadow" region, but modified by the presence of the *North Sea*, open to cold influences from higher latitudes.

The western hills are principally devoted to *pasture*, the midland plains to *mixed farming*, and the south-eastern valleys to *fruit*, *wheat* and *root-crops*. *Sheep* are reared in every hill-region, *wool* has been a staple product since the days of Edward the Third. The demand has far outgrown the home supply, and large quantities are imported from *Australia* and *South America*. *Cotton* has passed wool in importance as an English industry. The raw cotton is, of course, imported. In manufactures of all kinds Great Britain and Ireland have taken a foremost place. *England*, *Wales*, and the *lowlands of Scotland* are exceptionally rich in *coal*; *iron*

is present in considerable quantity, but immense quantities are imported, chiefly from *Sweden*, *Algeria* and *Spain*. *Shipbuilding* is more important than in any other country. The *carrying trade of the world* is largely done by British ships. *Engineering* is a prominent industry. *Railways* are highly developed; practically all systems converge on *London*, with its six to seven million inhabitants. *Liverpool* and *Glasgow* take first rank among the world's ports. *Cardiff*, *Hull*, *Belfast* and *Newcastle* are busy shipping outlets. *Leeds* and *Manchester* are the centres of the textile trades. *Sheffield* and *Birmingham* are foci of the steel and iron industries. *Edinburgh* is the capital of Scotch life and *Dublin* the metropolis of the Irish.

In the **warm temperate belt** we have the island groups of the *Bermudas* and the *Bahamas* on the American side of the Atlantic, the British stations on the *Mediterranean* (Gibraltar, the Maltese islands and Cyprus), and the continental plains of lower (northern) *Egypt* and *Northern India*. These fall easily into four groups:—

(*a*) The Bermudas and the Bahamas.
(*b*) The stations of the Mediterranean.
(*c*) The plain of Lower Egypt.
(*d*) The plains of Northern India.

(*a*) and (*b*) present *insular* or *equable* types, being islands in low latitudes.

(*c*) and (*d*) offer some similarities in being *continental*, but more contrasts from the fact that *Egypt* is practically *rainless*, whilst the plains of *India*, with the exception of the *Thar desert*, receive *considerable rain*; moreover, the plains of India are protected from cold influences by the sheltering wall of the *Himalayas* (the highest of the world's mountain ranges) on the north.

(*c*) and (*d*) might almost be classified with *tropical types*. Indeed, (*a*) *also*, since the islands lie in the track of the warm Gulf Stream Drift* from tropic latitudes.

The Bermudas represent the coral-encrusted summits of a mass rising out of 2500 fathoms of water. They are no part of the continental shelf, but *true oceanic islands*. Temperature is tropical, range of temperature is very low, *rainfall* is considerable. The islands have valuable tobacco plantations; many market-gardens supply American cities with "*early*" *vegetables*.

The Bahamas, on the other hand, are fragments of a coral reef built upon the *continental shelf*. They represent a continuation of the physical features of *Florida*. They scarcely belong to the West Indian group, differing as they do in structure. As in Florida, the *porous soil* makes *fruit-growing* more profitable than tobacco and sugar planting. *Sponge fisheries* employ a few of the inhabitants. *Nassau* is the capital. Though just *outside the tropics*, climatic conditions are similar to those of oceanic islands within the torrid belt.

The stations on the Mediterranean are situate in a latitude 5° N. of the Bermuda group, and within a *land-locked sea*. They therefore present many contrasts with the Bermudas and Bahamas. The soil is more rocky; the mean annual range is greater; the winters are colder.

Gibraltar is a mass of *limestone*, almost an island, protected somewhat from Atlantic breakers by the promontory of *Tarifa*. It is strongly fortified, and commands the entrance to the Mediterranean. It offers facilities for coaling.

Malta is the largest island of a small group rising from the *submerged bank* which divides the Mediterranean into *two depressions*, and links *North Africa* with the *Italian peninsula*. *Gozo* and *Comino* are the other members of the

* *Not* the Gulf Stream.

group, and all are British. The principal harbour (*Valetta*) is on Malta. Like Gibraltar, it is chiefly valuable for its *strategic* purposes. Both stand on the important *Mediterranean highway*.

Cyprus stands somewhat away from this important trade route, and, moreover, has no really good harbours. The prosperity of the island has decayed under Turkish influence. Its principal use to Great Britain is as a strategic outpost in Eastern Mediterranean waters.

Lower Egypt, around the *delta of the Nile*, falls outside the Tropic of Cancer. *Aswân*, the point at which the great barrage has been constructed across the river to serve the purposes of irrigation, stands on the tropic line. Other barrages have been built at Assiut and at the point where the Nile begins to distribute into the Delta. The region is practically *rainless*: hence the necessity for *irrigation works*. Where no river-floods are experienced, and no irrigation is done, the country is barren *desert*. At the same time the soil only needs water to make it one of the most fertile. The *Nile delta* is one of the most productive regions in Africa. *Range of temperature* is fairly low, not more than that of the British Isles; from its latitude, however, summers and winters are both 20° F. hotter than ours. The home of advanced, ancient civilisations—under British protection, Egypt has gained in importance and prosperity since 1869, when the opening of the *Suez Canal* made her ports stations upon the *water-thoroughfare* from Europe to the East. *Cairo* is the centre of activity. *Alexandria* and *Port Said* are the shipping outlets. A network of railways is spread over the delta; *wheat*, *dhurra* and *maize* are the principal cereals; *cotton*, *sugar* and *rice* thrive. Cotton is grown for export.

The Plains of Northern India are even hotter than Egypt. The reason is clear, for Egypt opens towards the *north*, whilst the Indian lowlands open toward the *south* and a *tropical ocean*. The western plain of the *Indus* presents several contrasts to the eastern plain of the *Ganges*, whilst a desert divides them (*Thar Desert*).

Rainfall is low in the Indus Basin and exceptionally heavy in the Ganges Valley; this is due to the fact that the rain bearing *south-west monsoon* strikes towards the north-east, and is therefore little affected by the *western* ranges of North India, but deposits its rain on the flanks of the *eastern* section of the Himalayas, making the Ganges Basin one of the *rainiest in the world*, whilst the Indus Basin is, on the whole, one of the *driest* (*see* Fig. 307). The upper Indus region, that of the *Punjab*, more closely resembles the Ganges country, being a sharer in the rains of the Himalayan slopes.

The tropical products, *cotton*, *sugar* and *rice*, thrive on the alluvial lands; *wheat* and *wool* are characteristic productions of the drier west, and *indigo*, *tea*, *jute* and *opium* of the damper east. The Himalayan slopes are clothed with *forests* almost to the snow-line; *tea plantations* are numerous on the lower slopes.

The *perennial snows* of the lofty *Himalayas* make a land of innumerable rivers, and their seasonal floods have made the *Punjab* and the *Ganges Valley* exceptionally fertile. *Irrigation* now distributes the life-giving water, and prevents disastrous inundations. Both valleys are served by important railways, which connect at *Lahore*. *Karachi* is the western outlet, *Calcutta* the eastern. *Karachi* is just outside the tropic, *Calcutta* just within. As the capital of the Indian Empire, and the outlet of the richer Ganges Valley, Calcutta is far more important. *Delhi*, *Agra* and *Allahabad* are important cities on the *Jumna* section of the Gangetic plain.

2. Units of the Empire in the South Temperate Zone.*

Leaving the units which fall within the tropics to a later section, we have next to consider those parts of the Empire which fall in the *South Temperate Zone* beyond the *Tropic of Capricorn*. These comprise :—

(*a*) The Falkland Group and South Georgia.
(*b*) South Africa beyond the Limpopo.
(*c*) West and South Australian fertile belts.
(*d*) The more important half of Queensland.
(*e*) New South Wales, Victoria, and Tasmania.
(*f*) New Zealand.

The Falkland Group lie on a projection of the *continental shelf* eastward from the shingle desert of *Patagonia*, and within equal distances of the *Straits of Magellan* and *Cape Horn*. Their average latitude corresponds to that of *England*, but their summer temperature (January) is 10° F. colder than ours (July), whilst their winter average is 4° F. lower. This is due to *Antarctic currents*, which sweep round *Cape Horn*. The climate is equable, though rainfall is only medium. The rocky soil is better than that of the mainland rain-shadow region. *Port Stanley* exports *wool* and *tallow*; it also collects *sealskins* from the scattered islands (belonging to the Empire) which lie farther south in colder latitudes.

South Georgia is a group of islands away further south.

South Africa, beyond the Limpopo, includes *Cape Colony*, *Natal* and the recently acquired territories of the *Orange River Colony* and the *Transvaal*. The climatic features of this part of the Empire have been worked out in Chapter III. The region falls naturally into three sections :—

(*a*) The coastal belt with considerable rains.
(*b*) The Veld tableland sloping westward with low rainfall.
(*c*) The desert basin of Kalahari.

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* These are taken before the Tropic types for purposes of comparison with the North Temperate types.

Cape Colony occupies the whole region south of the *Orange River*. This includes a strip of the coastal belt, as well as a portion of the inland Veld. **Natal** is confined to the coast-lands. The Transvaal and Orange River colonies correspond in type to the interior of Cape Colony. Even the coast-lands of Cape Colony from the *Cape* to *Port Elizabeth*, on *Algoa Bay*, are rather of the veldt type, facing southward, and receiving scant rainfall. It is the eastward-facing belt, backed by the lofty *Drakensberge*, which receives most rain; this is because the *Indian Ocean* is the rain-source for South Africa. *Natal* and *Kaffraria* thus differ in climatic type from the rest of South Africa. It is here that the *Kaffirs* are most numerous, outnumbering the British by five to one. In this damper region *subtropical productions* are obtained—*sugar*, *tea*, *coffee*, *arrowroot*, *cotton* and *tobacco*. *Coal* is mined in Natal. *Durban* is the outlet and *Pietermaritzburg* the capital of Natal.

The Cape and the Veldt find their outlets in *Cape Town* and *Port Elizabeth*. From these ports as bases, railways have climbed the terraces of the *Karroo* and pushed forward in the one case, to the *Zambesi*, and in the other to the *Tropic of Capricorn*. The longer railway follows the frontier of the old Boer states, and practically divides the steppes and wastes of *Bechuanaland* and *Kalahari* from the grassy *Veldt* of the *Orange River* and *Transvaal colonies*. *Rainfall* decreases from east to west on the plateau. Fertility naturally decreases in the same way. The desert fringe along the coast, both north and south of the Orange River, serves to emphasise the inflow of rain-winds from the Indian Ocean, and not from the Atlantic, on the whole.

Minerals contribute far more to the wealth of South Africa than agriculture. *Gold* is plentiful in the *Transvaal* quartz ridges. *Diamonds* occur in the blue clays of the igneous rocks around *Kimberley*. *Sheep* and *ostriches* thrive on the dry terraces and veldt. Gold, diamonds, wool

and feathers are the prominent exports. The small peninsula which runs out into the capes of *Good Hope* and *Agulhas* is an exception in the matter of rainfall; it receives a small amount in winter from the cool south-west. This adds to its fertility, and makes *vineyards* possible.

Johannesburg is the seat of the gold-mining industry. Its nearest British port is *Durban*. *Pretoria* is the seat of government in the Transvaal: *Bloemfontein* is the capital of the pastoral colony of the Orange River. The shorter railway mentioned above links these centres with *Port Elizabeth*. The student should especially notice the *use of rivers as frontiers* in this part of the Empire. They have little value for navigation.

South Africa corresponds in average latitude with *Lower Egypt* and the *Plains of India*. In type it belongs rather to the *Indus Basin* than to the rainless *Nile region* at the one extreme or the exceptionally rainy and fertile *Gangetic plain* at the other. As we noticed in Chapter III., it is with *Australia* that we can draw most profitable comparisons.

West Australia politically covers one-third of the continent. Only the *south-west corner* is really available for settlement. The interior is a bare, torrid tableland, almost *rainless*, and therefore very deficient in water supply, but affording some compensation in its valuable *gold resources*. Nearly a score of goldfields have been opened up, several of which fall within the tropics.

The *south-west division* repeats on a larger scale the conditions of climate obtaining in the south-west corner of *Cape Colony*. Rainfall is rather more plentiful, and the belt of *savannah country* (mixed trees and grass) is wider. The interior reproduces the climatic conditions of *Kalahari*. *Perth* and *Albany* are the important outlets. Each goldfield naturally seeks to set up a port at the nearest convenient

point on the coast. *Timber*, especially the valuable *jarrah-wood*, and *wool* are the staple exports of the south-west division. The colony has possibilities in *fruit-growing*.

South Australia very closely reproduces the conditions of West Australia. It has more *tropical-forest belt* (in what is geographically North Australia); it has a scrub-covered *salt-basin* rather than a torrid tableland; its southern peninsulas are scarcely so well favoured in the matter of rainfall. It has the advantage of long, fiord-like gulfs and several important streams from the regions of heavier rainfall to the east. Having little share in the tableland, it lacks gold resources. *Agriculture* counts for more than mining. Valuable *copper ores* are mined, however, in the Flinders Range. *Wheat* is here more important than elsewhere in the continent. *wool* and *wine* are important exports.

Adelaide is the capital and principal gateway of trade, it is linked by railway with all the mining centres; many of these also use small ports on the *Spencer Gulf*. Railways have now penetrated the lake region, along the line of the Overland Telegraph (perhaps destined to be the line of an overland railway route), as far as *Oodnadatta*. The student will see that Spencer Gulf was at one time the natural outlet for the overflow of *Lake Torrens*.

The three colonies of **Victoria, New South Wales, and Queensland** resemble one other, and recall the conditions of *South Africa* in having a grassy interior, shut off from a coastal belt by a mountainous wall running parallel to the coast. The interior is one in type with hotter and colder sections, yet geologically and hydrographically it is easily divisible into two units:—

(*a*) The northern region of creeks running to inland lakes.

(*b*) The southern basin, draining by the Darling-Murray system to the Southern Ocean.

The Queensland Interior stands higher than either the *Murray-Darling Basin* or the *Eyre-Torrens Salt Lake Region*. It is covered with *Secondary Rocks* of a chalky nature. Its streams diminish in volume as they proceed from the rainy uplands on the east to the parched salt basin on the south-west. *Sheep-farming* is the principal occupation. *Cooper's Creek*, the most important of the streams, reaches *Lake Eyre*; the *Warrego* joins the *Darling* across the New South Wales frontier.

The Darling-Murray Basin is a region of *Tertiary Sediments*, amongst which sands and gravels predominate. Its climate is *cooler*; the country is *better supplied with water*; *access to the sea is easier*. The boundary range partakes more of the nature of a *mountain-wall* than in Queensland, where it broadens out into a cordillera. The mountain-wall forms a distinct *rain-barrier*; the rain-winds of New South Wales blow in from the *Pacific*. Rainfall is *five times* as heavy at Sydney as on Lake Eyre. Agriculture is dependent on *irrigation*; *sheep-farms* are more profitable. This basin is the *principal wool-growing region* in the Empire. The mountain slopes overlooking the grassy interior are rich in timber-forest—the *eucalyptus* and *gum-trees* being characteristic.

Bourke, on the Darling, is the principal wool-collecting centre. The three capitals of the colonies are the natural outlets of the interior, to which they send out railway lines from the coast.

The coastal belt can fairly be divided into three sections corresponding to the three colonies.

Queensland Coastal Belt.—From *Brisbane* to *Rockhampton* we have the busiest and most settled part of the colony. The latter town is at the outlet of the *Fitzroy River* and on the *Tropic of Capricorn*. The dividing range is here no longer a range, but broadens out considerably, leaving "*bays*" *of*

coastal plain rather than a continuous belt. One of these opens out at *Brisbane*, another at *Maryborough*, and the third and largest at *Rockhampton*. It is in these basins that agriculture prevails. *Maize*, *sugar*, *arrowroot*, *cotton*, *coffee*, *oranges* and *pineapples* indicate proximity to the tropics. *Wool* comes over the mountains, *viâ Toowoomba*, to *Brisbane*. *Gympie*, on the plateau south of *Maryborough*, has gold mines. *Brisbane*, the capital of the colony, is placed at the end farthest from tropic conditions.

New South Wales Coastal Belt.— This is shut off from the interior by the *Blue Mountains* and the *Liverpool Range*. It receives its rain from the *Pacific*, and, being backed by a mountain wall, its rainfall is as heavy as that of most regions outside the tropics (average 50 ins.). The result is a strip of country of considerable fertility. Range of temperature is much lower. Climatic conditions correspond to those of *Natal*. *Sydney* is 20° latitude nearer the Equator than London is.

Tobacco, *oranges*, and even *sugar*, are among the productions of this belt; *coffee* and *rice* are being tried. *Wheat* and *maize* give place to *wool* (from the interior) as the staple export of the colony, but are grown in considerable quantities. *Coal* occurs here much in the same way as in the Drakensberge. *Silver*, *copper*, *tin* and *gold* are mined. Next to Sydney, *Newcastle* is the most important outlet. As the student will expect, its principal export is *coal* for the other towns of the colonies. *Sydney* is thirty times as large as this Australian Newcastle.

Victorian Coast Belt.—In this section the *dividing range* runs west to east, and so acts less as a rain-barrier than in the other colonies. Moreover, complications of rain-distribution arise from the *second source* of rain in the southern ocean. Thus, in *Tasmania* it is the western half that gets the heavier rains. The complex causes result in a *middle*

wet belt, with two drier regions, one to the west and one to the east.

The *Australian Alps*, the highest part of the dividing range, receive the heaviest rains. *Gippsland*, to the south-east, is comparatively dry, like the western half of the Victorian seaboard. Dry summers allow the cultivation of *wheat*, which is the principal crop; *meat*, *wine* and *timber* are considerable exports. The *gold* export is declining, the sources having been worked for more than half a century. *Ballarat* is the mining centre on the outward flank, and *Bendigo* on the interior slope of the dividing range. *Melbourne*, aided by *Geelong*, does the bulk of the trade of the colony. The most important export is *wool*, from the interior.

Tasmania belongs in type to the Victoria Coast Belt. It is more *mountainous*, has *heavier rains*, and even more nearly approaches *British conditions of climate*. Nevertheless, its average latitude is 10° less than that of England. *Timber* and minerals are the exports of this mountainous island. *Wool* and *fruit* form secondary exports. *Launceston* is the principal outlet, though *Hobart*, the capital, stands on a navigable river.

North Island, N.Z., has an average latitude equal to that of *Melbourne*. The climate differs in some ways from that of Victoria and New South Wales. *Rainfall* is heavier, and is densest on the western slopes. No part of the island is so dry as the sheeplands of the Australian interior. *Hawke Bay* is the driest province in the islands. *North Island* is less densely peopled than *South Island*, but it has the two principal ports of the colony, *Wellington* and *Auckland*, which are most advantageously placed with regard to trade routes. The interior is *volcanic* and little developed. The coastal belts grow *maize*, *oranges*, *lemons* and *olives*.

The seaward slopes support forests of *kauri-pine*. New Zealand *flax* is grown for export.

South Island (sometimes called Middle Island) being in conditions of latitude similar to those of *Italy*, is on the whole cooler than that country. Its average temperature is 55° F., while that of Italy is 64° F. Climatic conditions most nearly approach those of our own islands. The summer isotherm is 60° F., which is also that of England. The winter isotherm (45°F.) is 5° warmer than that of England.

Of all the Australasian colonies, South Island best suits the British emigrant as regards climate. The *rainy western flank* is too steep for agriculture. Fine *forests* clothe its slopes. A small *coalfield* occurs behind *Hokitika* in the northern half of the island. Bays of coastal plain occur at the southern end of the island and along the eastern seaboard. Rainfall is sufficient to make agriculture profitable, but as yet *sheep-rearing* is the principal industry. *Wool*, *meat* and *timber* are thus the principal exports. *Christchurch* and *Dunedin* are the best harbours. *Invercargill* is conveniently placed as a port-of-call for ships sailing to and from Australia *viâ* Cape Horn.

Scattered over the seas around New Zealand are several groups of small islands belonging to the British Empire: Norfolk Island, Chatham Island, Antipodes Island, Auckland Island, etc.

As in the case of South Africa, the student will note that the extra-tropical portions of Australia and North Island (N.Z.) belong to the *warm temperate* or even *sub-tropical belt*. Only South Island (N.Z.) approximates to the British Isles in climatic conditions. Nowhere do we find developed colonies in the southern hemisphere at all comparable in climate with Canada.

Having contrasted the rigorous climatic conditions of Canada with the warmer climates of South Africa and Australia, and noted the reasons why Lower Egypt and the

plains of India might be classified with tropic types, though falling outside the tropic boundary, we now turn to British possessions within the Tropics, and note how, once again, two groups arise characterised by—

(*a*) Heavy rains and equable climate;

(*b*) Low rainfall and some extremes of climate.

Naturally the vegetation and agricultural possibilities of the different types will differ.

(*c*) GEOGRAPHICAL UNITS OF THE EMPIRE WITHIN THE TROPICS.

The West Indian Group may be taken to include all our possessions around the *Caribbean Sea*, whether insular or coastal. *Jamaica*, *Barbados* and *Trinidad* are the most important islands. *Guiana* and *Honduras* are strips of shoreland on the mainland. Climate is truly tropical; mean annual range is only about 8° F. *Lowlands* are damp and unhealthy. The *slopes* are covered with forests of *mahogany*, *ebony*, and other *cabinet-woods*. *Cotton*, *sugar* and *tobacco* are the staple products of the lowlands. *Coffee* and *bananas* thrive on the lower slopes. *Kingston* (Jamaica), *Belize* (Honduras) and *Georgetown* (British Guiana) are the outlet ports. They may develop even greater possibilities with the opening of the *Panama Canal*.

The West African Group of possessions includes no islands, but a series of *strips of country* stretching back to the *plateau-rim* which shuts off the dry interior from oceanic influences. Only in the case of *Nigeria* has British enterprise pushed as far as the desert fringe of the *Sahara*. The *Gambia River Settlement* has never done much. *Sierra Leone* (Lion Ridge) is proverbial for its unhealthy climate. The Gold Coast Colony is healthier, because it has a more hilly coast line. *Nigeria* includes the unhealthy delta and the healthier interior of the Lower Niger country—a region of dense native population. *Temperature* is excessively high,

rainfall is excessively heavy; hence on the lowlands occur steaming *swamps*, which give the coast its unhealthy, malarial character. The region is valuable for the exports of the tropical forest—*oil* and *rubber*. *Ivory* is an export from the various outlets, but the elephants roam over the belt *within* the plateau-rim. *Bathurst*, *Freetown*, *Accra* and *Bonny* are the principal outlets. *Kumasi* and *Lagos* are capitals. *Kano* is the great mart of exchange between Arab traders and Nigerian dealers.

The **East African** tropical possessions fall into two groups:—

(*a*) Those of the Nile Basin and the Indian Ocean seaboard.

(*b*) Those of the Central African plateau from Lake Tanganyika to the River Limpopo.

(*a*) **The Nile Countries** within the tropics are really British possessions, not merely under British protection. Above *Wady Halfa* we reach *Nubia*, the *Nilotic Soudan*, and the *Uganda* Protectorate, the last of which occurs on the lake-plateau of the Nile sources. Linking this plateau with the Indian Ocean we have the *East African Protectorate*. Port Florence on the large *Victoria Nyanza* is one terminus of a railway which establishes communication between the Upper Nile and the nearest port on an ocean (*Mombasa*).

Cut off from this long, broad chain of possessions by the volcanic plateau are the territories along the coasts at the ocean outlet of the Red Sea.

British Somaliland is a strip of country facing a narrower strip of territory on the Arabian shore, which has its base at *Aden*. The island of *Socotra*, holding a strategic position in the Gulf of Aden, as well as the speck of the *Island of Perim* in the very gateway of the Red Sea, are British possessions.

Nubia.—From *Aswân* to *Berber*, the Nile takes a zig-zag course around the base of the ancient *crystalline* ridge which cuts it off from the Red Sea. The ridge is bare, and scorched

by the tropic sun. West of the river lies the desert basin of *chalky* rocks. Between the two towns mentioned the river is with difficulty navigable over its rocky course; it breaks over five cataracts—rapids rather than waterfalls. The sixth cataract occurs higher up the Nile, just below *Khartûm.*

Khartum stands on the dividing line between the chalky desert country and the more fertile Trias sandstone upland basin of the **Nilotic Soudan.** It is therefore well placed as the seat of administration. From the volcanic tableland of independent Abyssinia come the *Atbara* and the *Blue Nile.* From the *Darfur* heights, to the west, come the less constant streams, which unite to form the *Bahr-el-Ghazal.* The low-lying region around *Fashoda* is one of alluvial lands, damp through floods rather than from direct rainfall, and offers possibilities in the growing of *cotton* and *tobacco.* Darfur highlands have for centuries yielded *iron* for the rude *implements* of the Sudanese.

The Uganda Country lies on the plateau, with the Nile for its western frontier. Across the river is the eastern frontier of the Congo Free State. Uganda proper occupies the *shore-lands* on the north side of that greatest of African lakes—the Victoria Nyanza. A *volcanic chain* forms the watershed dividing the Nile sources from the rivers draining to the East African seaboard. Mount Eglon is one of the chain.

The northern shore of Victoria Nyanza lies on the Equator. The height of the tableland (average 3000 feet) makes the climate more healthy than one would expect. In fertility the lake-shores exceed the plateau generally. *Rainfall* is only low. The tropical forests of the Congo are not repeated on this dry plateau. Timber trees do occur on the mountain slopes. The characteristic vegetation of the plateau is, however, the *tall grass*, amongst which a great variety of wild animals roam. *Ivory* is a staple export. A railway links Port Florence, on the lake, with Mombasa, on the seaboard.

The East African Slope is somewhat barren, especially in the northern section. The region traversed by the railway along the southern frontier is greater in possibilities. The development of *ostrich-farming* promises to be profitable. Neither **Somaliland** nor the Arabian shore-strip present many possibilities of profitable development. *Ivory* and *feathers* are exported in small quantity from *Berbera*.

Aden is a military station, built in the crater of an old volcano. Its climate is one of the most torrid in British dominions.

(*b*) **Possessions of the Central African Plateau.**—A strip of German territory, stretching back upon the plateau from the coast to Lake Tanganyika, divides the northern section of British territory, on the long East African tableland, from the more extensive and more valuable southern section, which extends from the southern end of *Lake Tanganyika* till it merges in the *veld of South Africa*, beyond the *Limpopo*. This region has no seaboard of its own. The Portuguese own the coastal plain, which, like nearly all tropical coast-lands, is unhealthy. The plateau possessions include :—

(1) *British Central Africa*, for ever associated with Livingstone's name and work, and

(2) *Rhodesia*, whose name itself recalls the commercial and imperial enterprise of Cecil Rhodes.

British Central Africa coincides with the trough in which lies *Lake Nyassa* and its overflow stream, the *Shiré River*. It does not include the Zambesi delta. *Blantyre*, named after Livingstone's home in Scotland, is the focus of activity.

Rhodesia is rather a broad, open *tableland* intersected by the *Zambesi*. Its wealth lies in its *mining possibilities* rather than in agriculture. Its elevation makes colonisation possible. The mines are managed by Europeans and worked by native or imported labour. *Gold*, *iron*, *copper* and *coal* are believed to be plentiful; prospectors have crossed the Zambesi from the south, and now mining operations have

been carried within 15° of the Equator. The development of Zambesia has been greatly advanced by the construction of the railway, not only to Buluwayo, the centre of administration, but over the Zambesi River, at the most interesting point in its wonderful gorge—the *Victoria Falls*. *Rainfall* is heavier than in the northern section of the plateau. *Tropical forest* is found along the Zambesi river course. Portuguese ports, like *Quilimane* and *Beira*, offer ready outlets for exports. They are linked by railway with the trunk line on the plateau.

Of our **Indian Empire**, the *Dekkan plateau* and *Lower Burmah* fall within the tropics. We have already noted the tropical character of the climate of the plains of India, which fall almost entirely outside the tropic limit.

The Dekkan is bounded on the north by the *Vindhya Ridge*; its western and its highest edge is represented by the *Western Ghats*; its lower rim runs parallel to the *Coromandel coast*. In the north, *volcanic outpourings* affect the configuration so that two rivers drain westward, the *Nerbudda* and the *Tapti*: otherwise the general slope of this ancient plateau is eastward, and the development of streams is in this direction. The plateau culminates to the south in the *Nilgiri* and *Cardaimon Hills* which terminate in *Cape Comorin*. The rivers have developed considerable upland basins on the plateau; they enter the *Bay of Bengal* by many distributaries. The upland basins grow excellent *wheat*, as well as *tea* and *coffee*. The slopes carry forests of *teak*. The low shoreland between the plateau-rims and the sea grow the usual tropical crops of *rice*, *cotton* and *sugar*. *Indigo* is a valuable product. The ridges of the plateau are somewhat poor in metals. *Gold* is worked, but *precious stones* are more valuable.

Climate favours Europeans much better than on the plains of India, although the latter are in higher latitudes. Altitude

and slope are responsible for coolness and healthiness respectively. *Nagpur* in the north, *Haiderabad* in the centre, and *Bangalore* in the south, are tableland centres. *Bombay* and *Madras*, on the shores, at the foot of opposite sides of the tableland, are the capitals and distributing foci for the Dekkan.

Ceylon is an outlier of this tableland, repeating the general physical characteristics, climate and productions of the *Nilgiris*. In each case the *rainfall* is above the average, for they receive rains from both monsoons. The *South-West Monsoon*, of course, brings the greater quota, but the *North-East Monsoon*, in crossing the broad *Bay of Bengal*, picks up moisture and deposits it on the hilly regions of South India and Ceylon.

Wheat is less important, owing to the hilly nature of the country; *coffee*, *tea* and *rice* are more important. Quinine, from cinchona bark, is a valuable export.

Colombo, down on the coast and well placed on the trade-routes, has advanced in importance far beyond *Kandy*, the old capital in the interior.

Ceylon is independent of the Indian Empire, whilst *Burma* is a part of it, and governed from *Calcutta*.

Burma is a land of lofty, *parallel ranges* and *intermont valleys*, opening out southward upon a *deltaic shore-plain*. The *Irawadi* is a considerable stream, with an immense delta. The lowlands here also yield *cotton*, *rice* and *sugar*. *Teak* is plentiful on the hill slopes. *Tropical forest* occurs. *Gold* and *precious stones* recall the Dekkan. *Tin* ores are remarkably characteristic of the north-south mountain axis and their continued chain in the islands of the *East Indies*. *Petroleum* is another peculiar product in the sandstones of the basin of Lower Burma. *Mandalay* is the capital and interior focus. *Rangoon* is the seat of trade and the outlet for teak, tin, oil, rice and sugar.

The East Indian Group of possessions includes the *Straits Settlements* and the provinces of *Sarawak* and *British North Borneo* along the fringe of the tabular island of Borneo. *New Guinea* belongs naturally to the *Australasian* tropic group. The *Malacca Strait* is the highway from the *Indian Ocean* to the *China Seas*, and hence is of great importance as a trade route. The strait is shut in between the mountain wall of the *Malay Peninsula* and that of the Dutch island of *Sumatra*.

The southern section of the mountain wall is now in the hands of the United Kingdom. *Penang* is the chief town in the Wellesley district to the north. *Singapore* is the key of the position at the extremity of the chain and the outlet of the strait. It is built on an islet, and now forms a *naval base*. From Singapore routes radiate to *China*, *Siam*, the *Philippines*, *Borneo* and *Australasia*. In addition to the Burmese characteristic exports, the Straits Settlements have specialised in *rubber*, obtained not from native forest, but from *plantations*.

The northern coast of Borneo has *coal* deposits; the shorelands grow *sago* and *tobacco*.

The Equator bisects the island of Borneo; wide ranges of temperature are therefore impossible, since days are practically equal in length all the year round.

The Australian Tropic Group may be taken to include the *northern half of Australia*, the south-east corner of *New Guinea*, and the scattered islands of *Melanesia* and *Polynesia*, of which the British own a considerable share. The continental mass affords striking contrasts. Its western section, ruled from *Perth*, is a bare, torrid plateau, with considerable gold resources. Only a narrow, coastal strip is fertile, and that is unhealthy. The middle section, governed from *Adelaide*, has a portion of the tableland in the interior; it offers less wealth of gold, and is practically useless. The coastal fertile

lands are broader, since they include the granite uplands which divide *Timor Sea* from the *Gulf of Carpentaria*. The eastern section coincides with the northern, and hotter, half of *Queensland*. The York peninsula and the broad belt between the *Dividing Range* and the sea, as well as the shore-lands of the Gulf of Carpentaria, are fertile and productive, owing to the fact that rains in North Australia come in from the north-east. The *sheep-lands* of the interior penetrate a little way within the tropic. Agricultural development has not proceeded far, except in Queensland. Tropical forest awaits exploitation. The ranges of Queensland are clothed with forests of *eucalyptus*. *Tea* is being profitably cultivated on the *Cape York peninsula*.

Port Darwin is the focus of trade and communication in North Australia; it has overland telegraphic cables to Adelaide. The Queensland trade centres are on the eastern coast. *Cooktown* serves the tea-growing districts. *Townsville* ships the gold supplies of *Charters Towers*. *Rockhampton* not only serves the gold-fields of the *Fitzroy River*, but sends a railway into the interior to bring down *wool* for export.

New Guinea is only separated from the Australian mainland, of which it is practically an outlier, by the narrow and shallow *Torres Strait* and the equally shallow *Arafura Sea*. The southern half of the island is low, fertile and (as one would expect under a tropic sun and heavy rains) unhealthy; it is, on the average, less than 10° from the Equator. *Bananas*, *oranges*, *sugar*, *maize*, *tobacco*, *sago* and *coco-nuts* are available for export. *Pearl-fisheries* are carried on in the shallow seas.

The scattered islands of Melanesia and Polynesia are of *coral origin* on a *submerged platform*. (*See* Sec. I., Chap. V.). They resemble one another in having an equable climate of great heat, heavy rains, and the usual tropical products.

TABULAR VIEW OF THE NATURAL REGIONS OF THE EMPIRE.

[The student should apply the principles of Chapter IV.. and make contrasts, comparisons and inferences, but not memorise the table.]

Region.	Rainfall Av'rage.	Range t°.	Av'rage Lat.	Annual Isoth'rm.	Chief Agricultural and Animal Productions.	Other Sources of Wealth.
The Kalahari Region.	5 ins.	22° F.	25° S.	75° F.	Scrub and ostrich feathers.	Salt.
The Eyre Torrens Salt Basin	5 ins.	30° F.	30° N.	70° F.	Scrub.	Salt.
Lower Egypt	5 ins.	25° F.	30° S.	75° F.	Millet, cotton, wheat.	Building stones.
Indus Plain	15 ins.	30° F.	28° N.	78° F.	Millet, cotton, wheat.	
The Veld—South Africa	20 ins.	20° F.	28° S.	72° F.	Cattle, ostrich feathers.	Gold and diamonds.
Canadian Interior	20 ins.	70° F.	53° N.	36° F.	Wheat and horses.	Coal and furs.
The Darling-Murray Basin ...	20 ins.	25° F.	35° S.	65° F.	Wool and wheat.	Copper and gold.
North Australian Interior ...	20 ins.	20° F.	20° S.	80° F.	Scrub.	Gold.
Somaliland	25 ins.	5° F.	10° N.	80° F.	Wheat, grass, ivory.	
Zambesi Tableland	35 ins.	18° F.	16° S.	80° F.	Wheat, grass, ivory.	Gold, coal.
The East African Plain	40 ins.	5° F.	0°	80° F.	Wheat, grass, ivory.	
The Upper Nile Country	40 ins.	15° F.	10° N.	80° F.	Dhurra, cotton, tobacco.	Iron.
The Dekkan Tableland	40 ins.	5° F.	15° N.	80° F.	Coffee, tea, wheat.	Gold, precious stones.
St. Lawrence Basin	50 ins.	55° F.	46° N.	40° F.	Apples, timber, pulp, dairy produce.	Copper and nickel ores.
Natal	50 ins.	15° F.	30° N.	70° F.	Sugar, coffee, tea, arrowroot.	Coal.
Tasmania	50 ins.	15° F.	42° S.	55° F.	Cereals, potatoes, hops, fruit.	Tin.
British Columbia	65 ins.	45° F.	52° N.	45° F.	Timber, salmon, fruits.	Gold and copper.
British Archipelago	65 ins.	20° F.	54° N.	48° F.	Cereals, potatoes, wool, dairy produce.	Coal, iron, lead, building stone.
East Australian Shores	65 ins.	18° F.	30° S.	65° F.	Timber, oranges, sugar, wine.	Gold, tin, coal.
New Zealand	65 ins.	15° F.	42° S.	55° F.	Wool, maize, wheat, timber.	
Jamaica and Honduras	75 ins.	8° F.	15° N.	80° F.	Sugar, cotton, coffee, tobacco, and cabinet woods.	
British Guiana	75 ins.	5° F.	8° N.	80° F.		
West African Colonies	75 ins.	5° F.	6° N.	80° F.	Oil, rubber, bananas, sugar.	Gold.
South Indian Coastal Plains ...	75 ins.	5° F.	12° N.	80° F.	Cotton, rice sugar, coffee, tea, tobacco, &c.	
Ceylon	75 ins.	5° F.	8° N.	80° F.		
The Ganges Basin	75 ins.	20° F.	25° N.	80° F.		
Lower Burma	75 ins.	10° F.	18° N.	78° F.	Cotton, rice, sugar, coffee, tea, obacco, teak.	Tin.
The Straits Settlements	75 ins.	5° F.	5° N.	80° F.	Cotton, rice, sugar, coffee, tea, tobacco, rubber.	Tin.
North Australian Shores	75 ins.	10° F.	12° S.	80° F.	Coffee, tea, rubber.	

(Figures in every case approximate.)

CHAPTER V.

Trade Routes of the Empire; Inter-colonial Trade; Problems of Imperial Commerce, Defence and Government.

We have seen in Chapter IV. that practically every kind of natural wealth that the earth affords is obtainable within the limits of the British Empire. The *Arctic belt* of Canada sends its furs. The *Tropic possessions* yield a bewildering variety of commodities which the home country cannot provide. Rubber and oil, spices and drugs, ornamental cabinet-woods, coffee and tea, cotton and rice, sugar and tobacco, ivory and ostrich feathers can be plentifully obtained from our equatorial colonies. Within the *Temperate Zone*, the continental areas of *Canada*, *South Africa*, the southern half of *Australia*, the northern half of *India*, and the island chain of *New Zealand* supply wheat and wool, fruit and meat, to make up for the deficiency of home production in these busy islands. The home country, in return, sends out *coal* and *manufactured-products*—textiles and machinery. *Cotton* and *woollen* goods are the primary exports—the cotton to *hotter* regions of the Empire; *e.g.*, India, South Africa, and Australia, the woollen goods to *colder* areas, like Canada and New Zealand. *Machinery*, *bridge-building materials* and *railway plant* are sent out in large quantities to serve the pioneer in young and prosperous colonies.

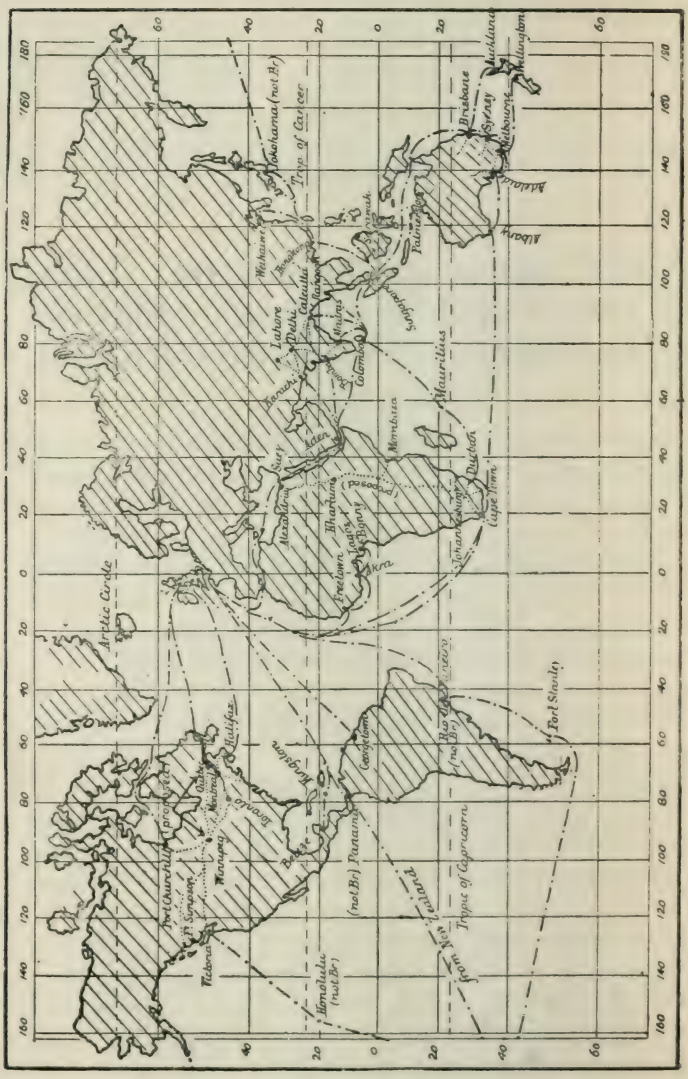

FIG. 316.—TRADE ROUTES OF THE EMPIRE.

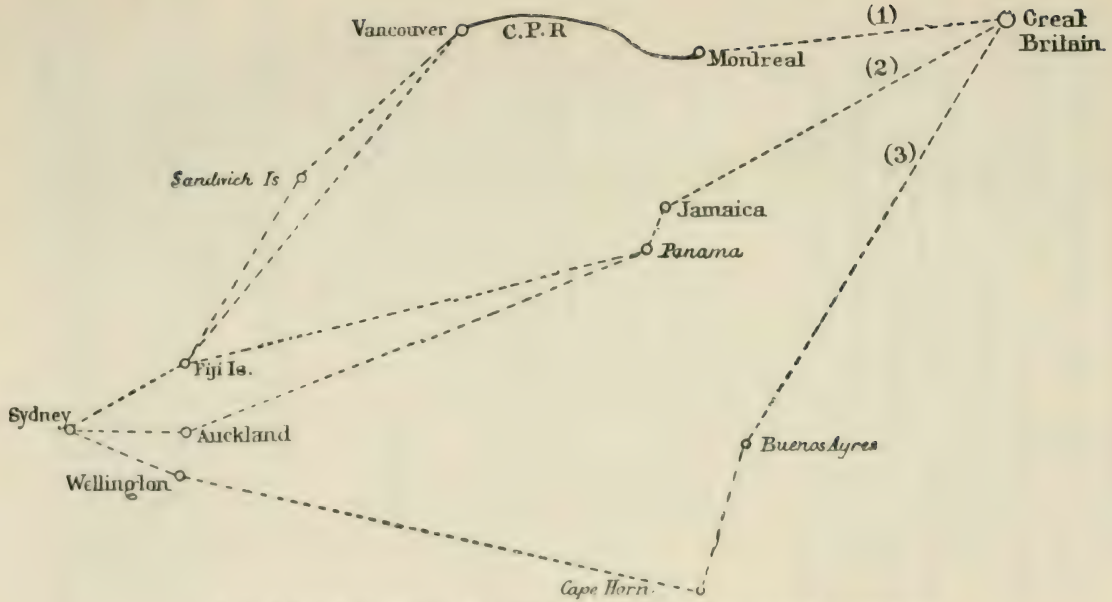

FIG. 317.—THE THREE WESTWARD TRADE ROUTES TO THE ANTIPODES.

Our imports from *India* (cotton, wheat, coffee, corn, tea, goats' hair, etc.) reach the enormous annual total of 40 millions sterling. Yet India takes from us even more, in the way of manufactured goods, her imports from the United Kingdom being five millions more. (1906.)

Australia sends us wool, meat, gold, copper, wine and timber to the value of 27 million pounds annually, and takes nearly 20 millions sterling in manufactured goods.

South Africa's imports from Great Britain far exceed her exports (gold, diamonds, feathers, wine, sugar) to the mother country.

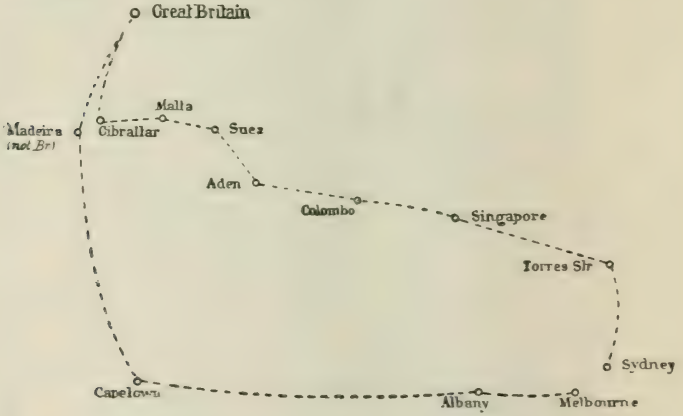

FIG. 318.—THE TWO EASTWARD ROUTES TO THE ANTIPODES.

Canada, on the other hand, takes from us only about half (£14,000,000), the value of the ores, timber, wheat, fruit and dairy produce she annually sends to the United Kingdom (26 millions sterling).

At present the *home country* takes rather more from her colonies than she sends out to the various parts of the

Empire; her total imports being roughly represented by 130 millions sterling, whilst her exports to the colonies only reach 125 million pounds in value.

Of course the colonies deal with other countries beside the United Kingdom. The tropic possessions interchange goods with their cousins in the colder colonies. Considerable trade also is carried on between the colonies and their neighbours outside the Empire. The *West Indies* and *Canada* do considerable trade with the *United States*. *Germany* and *France* each show a total trade of about 100 millions with British colonies, three-quarters of which is with the United Kingdom.

In this chapter we are chiefly concerned with the trade which is carried on between the home country and her colonies, and more with imports than with exports. The student is familiar with the products of British industry available for export. It is the aim of this chapter to draw his attention to the products which the British colonies can supply to meet the requirements of home industry.

A glance at Fig. 316 will reveal the existence of *four distinct trade routes* to the Antipodes, with a fifth which will become possible and prominent with the opening of the *Panama Canal*. Taking the five into consideration, we first remark that *three* of these take the *westerly* direction round the world, and the other *two* the *easterly* route (*see* Figs. 317 and 318). These may be called:—

1. The Canadian Pacific Route
2. The Panama Route
3. The Cape Horn Route

} westerly.

4. The "Cape" Route
5. The Suez Route

} easterly.*

* It is probable that an "overland" route through Persian territory will before long carry passengers to Calcutta, whence they may embark for the East or the Antipodes.

It will be simplest to take them in the order named:—

1. The Canadian Pacific Route.

The *Canadian Pacific Route* presents a longer mileage of railroad than any other of the five routes. It taps the resources of *Canada*, and allows their shipment either from the *St. Lawrence* ports to *Europe* or from *Vancouver* and the neighbouring harbours to *Japan*, *China*, *India* and *Australia*.

Steamers enter the *St. Lawrence* water highway either by the narrow *Strait of Belle Isle* or across the fishing-grounds of the shallow gulf. *Quebec* is the first important port, but *Montreal* is the headquarters of trade at the head of navigation for most ocean-going vessels, and has grown to a city twice the size of Quebec. The shallow gulf and the funnel estuary are, however, blocked by ice in winter (the January isotherm = −10° F., *i.e.*, 42° of frost), so that *Halifax*, a hive of industry, with a harbour always ice-free, has to serve as a *winter-port* for the St. Lawrence, in addition to serving *Nova Scotia* the year through.

The trough-like St. Lawrence valley has two lakes at its upper end—*Ontario* and *Erie*—connected by the *Niagara River*, which leaps over a limestone ridge in its middle course into a gorge—famous to the world as the Niagara Falls. Only here and at Lachine Rapids is navigation interfered with between *Montreal* and *Detroit* (U.S.A.). The *Welland Canal* gets rid of the difficulty of the falls.

A section of the *Grand Trunk Railway* hugs the river all the length of the valley on the Canadian side. The focus of industry on Lake Ontario is *Toronto*; that on Lake Erie is *Hamilton*. *Toronto* is a thoroughly English town. It exports the fruits of fertile south Ontario. *Quebec* is thoroughly French, and exports chiefly timber—*pine* from the northern forests and *spruce* from the southern slopes. *Pulp* and *paper* are accessory exports.

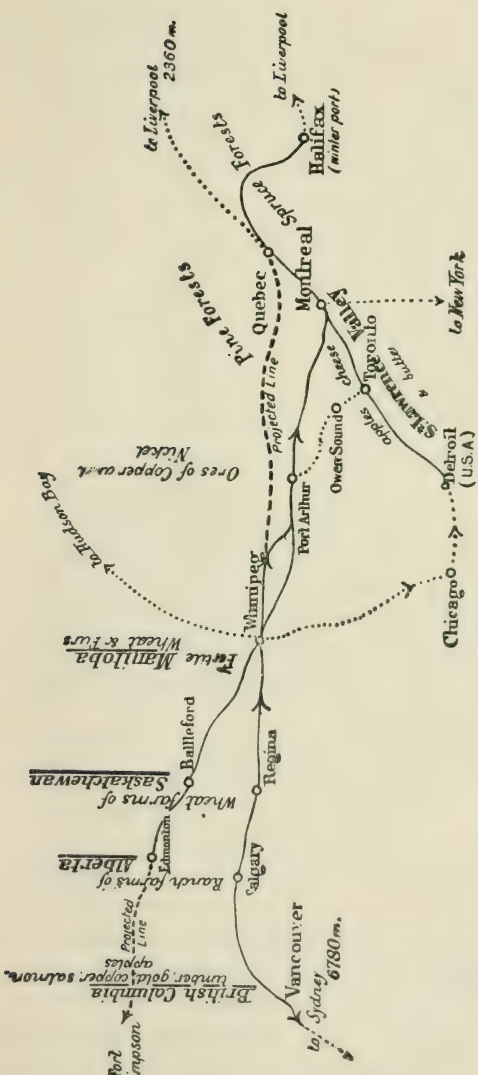

FIG. 319.—THE CANADIAN TRADE ROUTES.

Toronto is but little distance from the *Georgian Bay* of *Lake Huron*. It is already linked by railway to *Owen Sound*, and it is hoped soon to link it with Montreal by canal, so that lake steamers may avoid the circuitous route *vid* Detroit and the Welland Canal.

Just above Montreal the St. Lawrence receives the *Ottawa River*—a provincial frontier. Along the Ottawa valley, passing *Ottawa*, the seat of government of the Dominion, the Canadian Pacific railroad traverses the northern section of Ontario, less favoured in fertility and climate than the southern section, but more fortunate in its great mineral wealth. *Sudbury*, on the C.P.R., is the smelting centre. *Nickel* and *copper* are the principal ores. *Silver* is also found. The line then skirts the rocky northern shore of *Lake Superior*, and touches the lake at *Port Arthur*, the head of Canadian lake navigation. Port Arthur is beyond the mining regions and the convenient port of the *wheat-lands* further west. *Sault St. Marie* is a rival of Sudbury, standing on the rapids by which Superior drains into Huron. A canal on the Canadian side and two on the States side make negotiation of the rapids unnecessary. The main line passes through a belt of forest and then opens on the wheat-growing plains of *Manitoba*.

Winnipeg is the great emporium and traffic centre; from here the main line proceeds due west, keeping near the States frontier, whilst an important branch strikes north-west across the two arms of the *Saskatchewan* to serve the newer *corn-lands* and *stock-farms* which are pushing northward to the *Churchill River*.

Regina is in the region yielding the best wheat. *Battle-ford*, due north, on the branch line at its intersection with the Saskatchewan, is a newer emporium.

Similarly, *Calgary* is the rancher's capital on the main line, and *Edmonton* his northern market town. The C.P.R. divides before ascending the Rockies. The northern section

traverses the magnificent region of the *Selkirks*; the southern section takes the shorter route through the Crow Nest Pass, and picks up the exports of the mining centres of *Kootenay* and *Kamloops* before dropping down to the seaboard at *Vancouver*. The *Straits of Juan de Fuca* affords outlet from the sheltered harbours of *Vancouver*, *Victoria* and *Esquimault*, where steamers can obtain excellent coal from the pits on the inner flank of Vancouver Island. Were it not that the *Hudson Bay* is so hampered by ice, *Fort Nelson* might develop into a port for *Winnipeg*, with river-communication thereto, especially since it is much nearer Glasgow than any other Canadian port. As it is, it forms a base for trappers.

The *Gulf Provinces* and *Newfoundland* (the latter separate from Canada in government) have their respective ports in *Charlotte Town*, *Sydney* and *St. John's*. The last named is only 1700 miles from Galway.

Montreal finds easy access by the *Champlain-Hudson depression* to New York (U.S.A.).

Vancouver is the Canadian gate to the Pacific, as San Francisco is for the States. As yet it has no rival, but if the trunk line is carried over the Rockies from Edmonton, *Prince Rupert* (the prospective terminus), and *Fort Simpson*, opposite the *Dixon Entrance*, with coal supplies on the islands opposite, may expect to share the Pacific trade, and serve as outlets for the newer goldfields and corn-lands of the Dominion.

The Canadian Pacific Railway has its "Atlantic greyhounds" running regularly to our shores, and another fleet crosses the Pacific to our Antipodean colonies. *Suva*, in Fiji, is a convenient port-of-call for Pacific steamers in southern waters. *Auckland* (N.Z.) is the first port touched at in our Australasian Empire.

Winnipeg, *Toronto*, *Montreal* and *Quebec* have easy communication with the United States centres of *Chicago*,

Detroit, *New York* and *Boston*. An immense interchange of products takes place across the frontier. Of course the principal transfer is from the richer and more fully developed States of the Union to Canada; the imports to the Dominion are more than twice as much as her exports to the States.

Canadian exports to	Great Britain	28 million £	*
	United States	24 million £	
	France	½ million £	
	Germany	½ million £	
Canadian imports from	Great Britain	22 million £	*
	United States	56 million £	
	France	2½ million £	
	Germany	2 million £	

2. The Panama Route.

The *West Indian Colonies*, numbering more than a score of islands and two mainland territories, have traded with Great Britain since the seventeenth and eighteenth centuries. The earlier colonies were acquired by settlement; the later and larger colonies, including *Jamaica*, *Guiana*, *Trinidad* and *Honduras*, came to us by conquest or treaty in the wars of the eighteenth century. *Sugar* and *cabinet-woods* have been the principal exports. Latterly, the plantations have sent out tropical *fruits* and *coffee*. More trade is done with the *United States* than with Great Britain. The prosperity of these possessions has never been great. It is possible, however, that the opening of the *Panama Canal*, which will place them on the most direct route to the Antipodes, will give increased trade to this group of possessions—a tropic group, and the only calling-place between Great Britain, in the Cold Temperate belt, and Australia, with New Zealand in the Warm Temperate Zone beyond the Equator.

* Round numbers only (1911), for purposes of comparison.

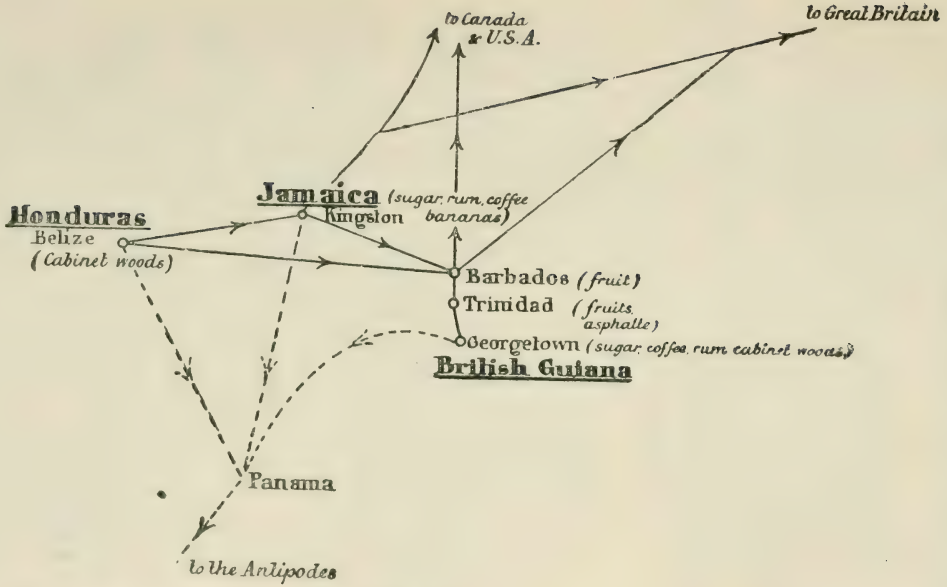

FIG. 320.- THE CONTRIBUTION OF THE WEST INDIAN GROUP TO THE MOTHER COUNTRY.

Honduras and *British Guiana* are mainland possessions. The former has a large export trade in *timber*; the latter in *sugar*.

Jamaica is the largest island; *Kingston* is the gathering place for "tramp-steamers" visiting the colonies.

Barbados, a small coral island, with its harbour on the inner side of the island, is the trading centre for the lesser Antillean group.

From *Panama* steamers will proceed to *Fiji*, *Auckland*, *Sydney* and *Melbourne*.

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3. The Cape Horn Route.

From Sydney and Melbourne steamers often round *Cape Horn* on the return journey, and touch at *Port Stanley*, in the *Falkland Isles*, our only port-of-call in the southern waters which surround the South American continent. *Wool* and *meat* are the only important exports from these grassy islands. Steamers call at one or other of the South American ports before striking across the Atlantic.

At present the *dominant* trade routes of the Empire are the *eastward* ones, *viâ* the *Cape* and *Suez* respectively. The Cape route serves *West* and *South Africa* at the same time that it links the *southern half of Australia* with Great Britain. The *Suez route* touches at our *Mediterranean stations*, taps the resources of the *Nile countries* and brings *India* and the possessions of the *Far East* into shorter water-route communication with the United Kingdom. Canal dues are heavy, and lead many Australian vessels to choose the Cape route.

East African ports, East Australian cities, and New Zealand can choose between the alternative routes. Of course Indian exports may come by the Cape, just as Australian vessels from Albany Bay may steam across the Indian Ocean to gain the Suez.

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4. The Cape Route.

Taking the Cape route first, we will notice the contributions of West Africa and South Africa in turn.

The *West African colonies* are well within the tropics, and have exceptionally heavy rains. *Tropical forest* occurs; low, swampy coast-lines yield abundant tropical produce. The colonies nearly all push over the plateau ridge, and serve therefore as outlets for the strongly-contrasted *dry interior*.

Bathurst, *Freetown*, *Cape Coast Castle* and *Accra*, *Lagos* and *Bonny*, are the ports at which tramp-steamers call to pick up the *ivory* and *feathers*, the *oil* and *rubber* which these

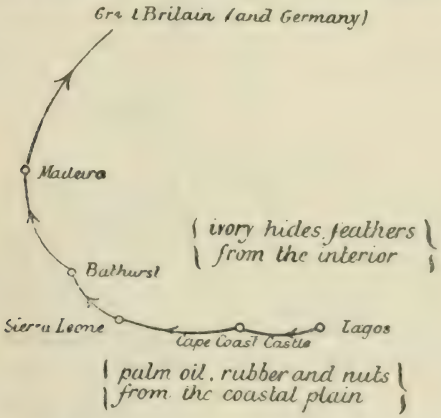

FIG. 321.—THE CONTRIBUTION OF THE WEST AFRICAN COLONIES TO THE MOTHER COUNTRY.

colonies have available for export. Leaving *Bathurst*, the vessels steam into the line of the trade-route. *Germany* ranks next to Great Britain in trade with our West African colonies.

The colonies of Africa beyond the *Zambesi* have little in common with those of West Africa. *Rhodesia* is as hot, but not nearly so wet. *Natal* is almost as rainy, but not nearly so hot. The *veld colonies* and the *Cape* are neither so hot

nor so rainy. Tropical forest products are to be had in the valleys of the Zambesi plateau. *Sugar* can be picked up at Durban. But the oil, rubber and sugar of South Africa leave little surplus for export. *Gold* and *diamonds*, *feathers* and *wine* are the staple exports; and these come chiefly from the dry tablelands.

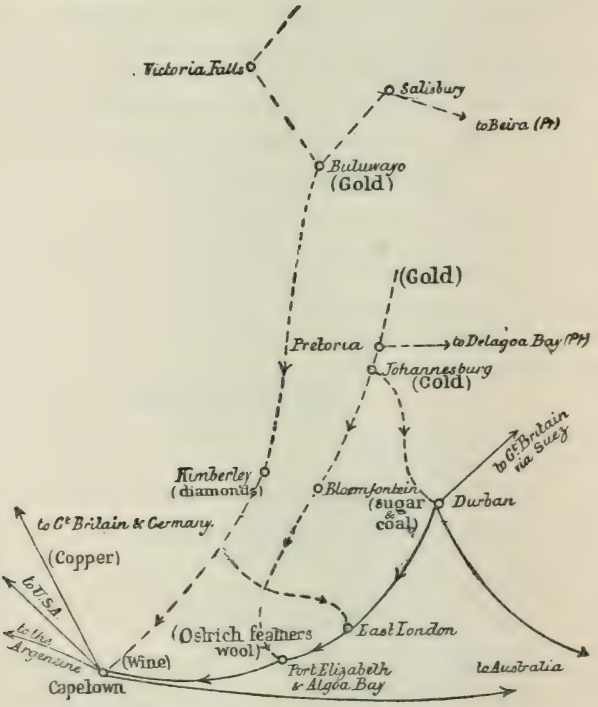

FIG. 322.—PRINCIPAL EXPORT LINES OF SOUTH AFRICA.

The mines have led to the railway developments and determined their direction. Two parallel lines cross the tableland, one near the desert fringe on the west, the other near the mountain barrier on the east. *Cape Town* and *Port*

Elizabeth are the respective termini. The western was the *All-British route* before the South African War (1900); the eastern traversed the Karoo of Cape Colony and the *Boer States* of the Orange River and the Transvaal. Now both are British. *Johannesburg* is the capital of the mining world of South Africa. It finds access to the seaboard through the rugged kloofs of the *Drakensberg* and the coal-mining region of Natal to *Durban*. Prior to British acquisition it used *Delagoa Bay*, on the Portuguese seaboard, to a larger extent than now.

Kimberley, the diamond market, is on the western line. The northern extension of this line, consequent on the prospecting of the *South African Chartered Company*, is the southern section of the late Cecil Rhodes' *Cape-to-Cairo* cross-continental project.

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5. The Suez Route.

The *Suez Route to the Far East* became especially important in 1869, when the newly-opened ship-canal made it possible for vessels to steam over the whole route from *England* to *India*, and thence forward to *China* and *Japan*. Great Britain is now the greatest shareholder in the canal, whose eighty-seven miles link the *Mediterranean* with the *Red Sea*.

The *Nile Trade Route* gains new importance from the development of Suez shipping. France has practically left *Lower Egypt* (which owns the suzerainty of the Sultan) to the protection of Great Britain. The *Upper Nile* country—the *Nilotic Soudan*, within the tropics—is British by conquest. This carries British interests to the sources of the Nile and the equatorial territory of *Uganda*. The purchase of the territorial rights of the *British East African Company* has brought the line of communication down to the seaboard, and made all-British communication by land between *Cairo* and *Mombasa* possible.

Cotton is the prime export of the delta; the desert belt supplies *dates*; the crystalline wall which shuts the Nile out from the Red Sea affords excellent *granite*.

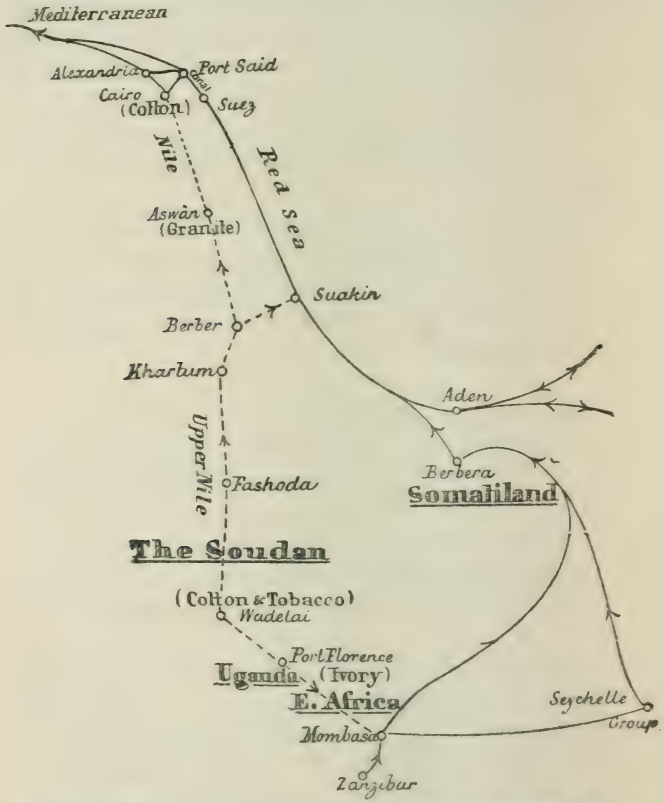


FIG. 323.—TRADE COMMUNICATION WITH EGYPT, THE NILE, THE SOUDAN AND EAST AFRICA.

The *Nilotic Soudan* is experimenting in *cotton* and *tobacco* which it can send down the Nile or by the East African Railway to Mombasa.

The East African colonies are little developed. They trade chiefly with *India*. *Zanzibar* has been for ages an Arab trading station. Its population numbers 100,000. *Cairo* is the great commercial city of Lower Egypt, and *Alexandria* the historic port. *Port Said* is the gate of the canal. *Suez* is unimportant. *Khartûm* is the prospering capital of the Nilotic Soudan. *Suakin* is the nearest port, and will be joined before long by rail through Berber. *Aden* is a strategic station on the Arabian littoral, and commands the Bab-el-Mandeb entrance to the Red Sea. The island of *Perim* stands in the gateway.

India differs from the other large colonies in sending to the United Kingdom more than she imports from the home country.

From the dry western section of the northern plain (*Indus valley*) come *wheat* and *goats' hair*. the one from the plain, the other from the mountains. *Karachi* is the outlet-gate. From the damper *Ganges basin* are exported *fibres* (hemp and jute) and *cotton*. *Bombay* is the convenient gate for the Upper Ganges region, *Calcutta* for the rich, damp, alluvial lands of Bengal. *Cotton manufacture* is proving prosperous in the vicinities of these capitals. The northern plain has navigable rivers and railway systems which follow their courses, since the towns were already on the river banks when railways were started. *Lahore* and *Delhi* are principal railway-foci. The *Deccan* finds its outlets in *Bombay* and *Madras*—the latter has poor harbour accommodation, the former has the best anchorage in India.

Colombo owes its importance to its position on the trade route even more than to its export of the produce of Ceylon and South India. *Cotton* and *tea* are the staple articles of export. *Teak* from the Nilgiris and *spices* are secondary exports. *Cinchona* is a valuable product.

Rangoon is the natural outlet of Burma. *Teak* from the mountain slopes, *tin* from the mountain veins, *cotton*

and *tobacco* from the delta-lands, and *oil* (petroleum) from the porous valley-sandstones make up the export trade of *Rangoon*.

Singapore, like *Colombo*, owes much to its position. Like *Hong Kong*, further east, it is built on an island. It forms a naval base and the convenient trade centre of the settlements along the *Straits of Malacca*. *Rubber* from plantations, *tin* and *spices*, are shipped from its quays. The northern half of *Borneo* sends off *tropical produce*. *Hong*

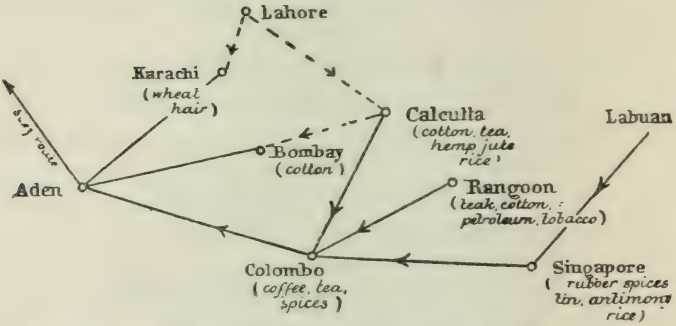


FIG. 324.—THE CONTRIBUTION OF INDIA, BURMA AND THE BRITISH EAST INDIES TO THE MOTHER COUNTRY.

Kong gathers Chinese *silk* for home use; it is still more important for its strategic position in Chinese waters.

Wei-hai-wei is our latest acquisition on the Chinese littoral

THE ANTIPODES.

The Antipodean group, including *Australia*, *Tasmania*, and *New Zealand*, can be approached by way of the five trade routes previously outlined. And, indeed, Australia and her neighbours do considerable trade with the colonies *en route*, more especially with those possessions whose climatic conditions, and therefore whose productions, differ widely from

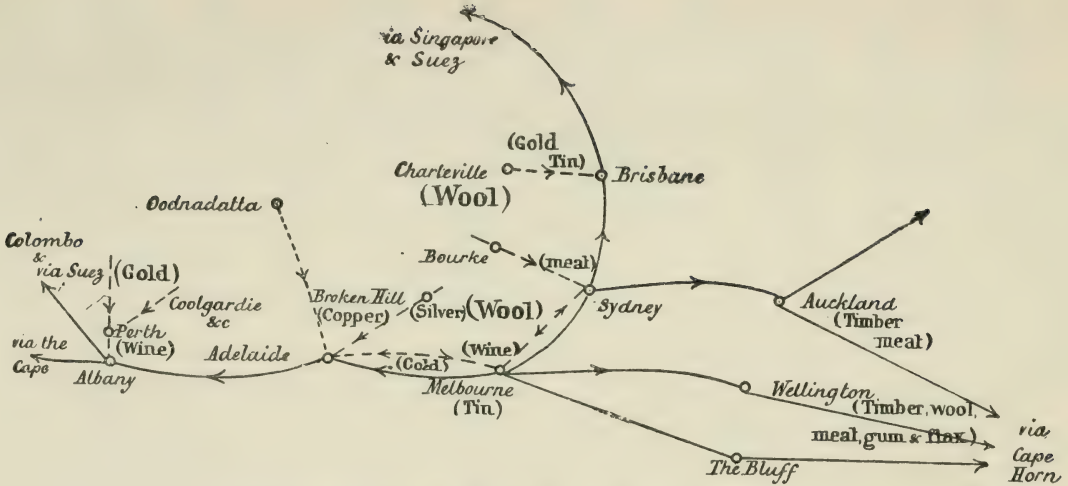


FIG. 325.—THE TRADE OF AUSTRALIA WITH GREAT BRITAIN.

her own. *South Africa* has much in common with Australia. As a result, Australian vessels largely make *Cape Town* a port-of-call on their way to and from Europe. *India*, to the west, and *Canada*, across the Pacific to the north-east, have a large amount of trade with "our cousins under the Southern Cross." The bulk of *Australia's foreign trade* is with that other, great, English-speaking community on the American continent—the *United States*.

Sydney, the first British settlement on the Australian continent, may be considered the meeting-place of the two eastward routes from England.

Melbourne, *Adelaide* and *Albany* (for Perth) are the natural outlets for the exports of their respective colonies. *Brisbane* is the only capital nearer the Equator than Sydney. From each of the capitals (all of which are placed on the sea-board) railways strike inland to tap the resources of the interior.

The eastern mountain wall yields *gold* and *tin*; the ranges of *South Australia* export *copper* and *silver* from *Adelaide*; the western plateau has many gold-mining centres, each with its outlet, and all with their gathering place at *Perth*.

Wool and *meat* from the interior find their way by radial lines of railway to *Brisbane*, or *Sydney*, or *Melbourne*. *Melbourne* rivals Sydney in all matters of trade and progress. *Gold* is now scarcely an important export. *Tasmania* is an outlier from Victoria in a trade sense, as well as in a physical connection.

New Zealand has three gates of shipping trade, one in the extreme north, another in the extreme south, and, the most important of all, in its capital, midway between. *Timber* and *meat* are the staple exports. *Flax* is a considerable crop. *Wool* and *Kauri gum* are important. Routes diverge to *Vancouver* (Canada), *San Francisco* (U.S.A.), *Panama*, *Valparaiso* and, *viâ Cape Horn*, to the Atlantic.

Suva, a port in the British group of Fiji, is a convenient port-of-call.

IMPERIAL RELATIONS.

It will be seen that the trade of the British Empire is of world-wide importance; *26 per cent.* of the whole world's trade is done by Great Britain and her colonies, which is nearly equal to the *aggregate trade* of *Germany*, *France* and the *United States*. The importance of trade routes to the prosperity of the Empire cannot be over-estimated. The necessity that all strategic points on these routes shall be sufficiently defended is evident. Thus *Gibraltar*, *Malta*, *Aden*, *Colombo*, *Singapore*, *Hong Kong* and *Wei-hai-wei* are strongly fortified stations on the eastern trade route; *Ascension*, *St. Helena*, *Cape Town*, *Durban*, *Mauritius*, *Albany* and *Sydney* are similarly defended; *St. John's* and *Halifax*, on the Atlantic side, and *Vancouver* and *Esquimault*, on the Pacific coast, guard Canada's trade route; the *Bermudas*, *Jamaica* and *Barbados* have naval bases from which to control trade in the West Indian Archipelago.

An Empire with such possibilities of trade presents innumerable *economic problems* which scarcely fall within the scope of a text-book of geography. Trade is the cement which binds our Empire together, even more than any filial sentiment of the younger colonies to the mother country.

At present, each *self-governing colony* makes its own trade regulations, frames its own tariffs and imposes duties to suit its own revenue-arrangements.

The question which is being most discussed, now that the trade of the Empire is so enormous, is whether the members of the Empire shall form a *Free-Trade union* within the Empire, with high tariffs against outside competing nations, like the *United States*, *France*, or *Germany*, or, on the other hand, merely give a "preference" to colonial imports over imports from foreign countries in the way of a reduced tariff. Considerable diversity of opinion exists among the members

of the Empire; the exporting colonies favouring preference, whilst the United Kingdom, if the general election of 1906 may be taken as an index, adheres to the policy of Free Trade all round, partly because the home trade with foreign countries is considerably in excess of that with the colonies, *e.g.*:—

Trade with colonies (export plus import) = £250 mills. ann.
,, foreign countries (,, ,, ,,) = £470 ,, ,,

How best to bind the Empire together by economic policies, which mean the highest welfare of all, is the fascinating and intricate problem which faces politicians and economists in the near future.

Next to trade, the problem of *imperial defence* is likely to engage the continued attention of statesmen and imperialists. At present the ***burden of defence*** rests on the home government, and the British taxpayer contributes beyond his arithmetical share to the naval provisions which are made along our trade routes.

Military defence is a more pressing local problem for each colony to settle and finance in its own area. *Naval defence* is likely to remain an *imperial charge*, and the problem is more difficult in the direction of devising some means by which each colony shall contribute its fair quota to meet the financial burden. The control of the navy from headquarters whilst contributions came in from all quarters would involve the "taxation without representation" which lost the American colonies to us, unless some form of central control could be devised with proportionate representation from each colony.

Such a body would approximate to an imperial parliament. The general opinion now is that such an executive is impracticable. It opens up the larger question of **Imperial Federation,** which has so often been taken up and as often dropped, owing to the inability to frame any scheme satisfactory to the different colonies to be federated.

The time is not ripe, it would seem, for such schemes to crystallise into any concrete form. Much remains to be done in educating the colonies and the home country before any unity of scheme is possible. Probably the idea is gradually working itself out in the Empire by such steps as the consolidation of Canada into one dominion and the federation of the Australian colonies into one great commonwealth. South Africa is the latest to follow their lead, and with the smaller, less compact groups of the West Indies, West Africa and the East Indies it is only a question of time.

An imperial parliament for imperial affairs may never come, and probably would prove impracticable with the *represented* units so scattered. But periodical conferences for the discussion of colonial affairs which affect the Empire as a whole, such as have come into fashion since 1897, the sixtieth anniversary of Queen Victoria's accession, cannot but help the idea of *Imperial Unity* by removing misunderstandings, throwing light on colonial problems, and fostering friendship between those who hold sway and exert influence in the many and varied units of the Empire.

The colonies themselves vary very widely in size, climate, productions, stage of development and racial factors.

The colonies in the *Temperate Zone* are principally peopled by *white races*, chiefly British.

Canada and *Australia* have no "native-race" problem since the aboriginal inhabitants are few in the one case and practically extinct in the other.

New Zealand has passed the race-problem stage by respecting the rights of the *Maoris*.

South Africa has its problem to face; *viz.*, how to weld Dutch and British into one, strong, progressive people, capable of self-government, animated by friendly relations and a desire to deal justly with the inferior *Kaffir* race, which forms so large a proportion of the population of the *New South Africa*, and whose members occupy the belt of tableland from the *Cape* to the *Zambesi*.

The *colonies in the tropics* are chiefly inhabited by native races of inferior civilisation. These are, as yet, incapable of self-government. They form "*Crown Colonies*," "*Protectorates*," or "*Dependencies*," administered from the home country. Extensions in the direction of self-government are made as the time is opportune and progress warrants. Federation has here made best progress. The units are isolated, but not so scattered that grouping would be impossible.

India, with its teeming millions and its many races and religions, forms the most intricate problem of British rule. Every aspect of the problem presents itself on a gigantic scale. Parliamentary government, based on the franchise, is out of the question for the country as a whole. *Mysore* approaches nearest to this of any of the subject states. India is an empire within itself, and the present duty of Great Britain, through the Emperor and his officers, is to administer the government of this land of many races and religions in as wise, firm, and benevolent a way as experience and insight can teach. British institutions will, no doubt, be set up as the people show themselves ready and capable of using them.

[The student should consult the various year-books for the latest aspects of imperial problems.]

The latest of the leagues formed to stimulate the idea of "Imperial Unity" has set out as its aims the promotion of trade, closer intercourse, protection of the trade routes, and the co-ordination of commercial and criminal law within the Empire.

The best cement of Empire is beneficent rule—each for all and all for each. We have reason to belive that British rule and British institutions bring to native and backward races a larger share of good than would accrue from the rule of any other Power. Some see in our widespread Empire the mission of the Anglo-Saxon race to uplift and succour the backward races of the world.

It would be well to supplement Chapter II. and the above chapter in this book by reading such works as:—

(*a*) Clough's *Expansion of the British Empire.*

(*b*) Seeley's *Expansion of England.*

(*c*) Dilke's *British Empire* and *Problems of Greater Britain.*

(*d*) Vol. V. in "The British Series." (Kegan Paul & Co.)

TABULAR VIEW OF THE COLONIES, ARRANGED ACCORDING TO FORM OF GOVERNMENT.

Self-governing Colonies, with Parliaments and Executives.	Crown Colonies with a Governor and a Legislative Council.	Protectorates with more or less Native Rule.
The Dominion of Canada. Newfoundland.	Malta. Cyprus. Ceylon. Straits Settlements. Hong Kong. British New Guinea.	Malay States. (British members.) Sarawak. Somaliland. British East Africa. Uganda. Bechuanaland. Nigeria.
Possibilities of Federation. — *Australian Commonwealth.* — New South Wales. Victoria. Queensland. South Australia. West Australia. Tasmania.	The various groups of the Southern Pacific. The various islands of the West Indian Group. British Guiana. British Honduras.	
New Zealand.	Gambia Settlement. Sierra Leone. Gold Coast. Lagos.	Strategic Stations.
Cape Colony. Natal. Transvaal. Orange River Colony.	Falkland Group. Mauritus and Seychelles.	Ascension. Aden.
Crown Colonies with a Governor only.	**Under Chartered Companies.**	
Gibraltar. St. Helena. Basutoland. Labuan.	Borneo. Rhodesia. British Central Africa.	*India*, including Burma, governed by Viceroy, Secretary of State and Council of Anglo-Indians.

CHAPTER VI.

Our Australian Commonwealth.

APPROXIMATE CO-ORDINATES OF—

Perth:	116° E. / 32° S.	Adelaide:	139° E. / 35° S.
Melbourne:	145° E. / 38° S.	Sydney:	152° E. / 34° S.

THE *Australian continent*, with its island outlier *Tasmania* has been generally considered in Chapter III., where many striking comparisons with *South Africa* are drawn. In that chapter great stress is laid upon the geographical units of the continent, their resources and their outlets. But the geographical and the political units do not correspond, except in a very general way. It will be profitable therefore to consider the *political* units in this chapter, at no time forgetting their relation to the fundamental geographical regions.

Politically, the continent is *cut up into units by lines of longitude and latitude.* Natural boundaries are few; the *Murray* is the only one of importance. Its affluent, the *Darling*, serves as a political frontier near its source.

The continent may be considered in three belts :—

(*a*) Western Australia.

(*b*) Middle belt—called South Australia.

(*c*) Eastern belt, comprising Queensland, New South Wales, Victoria and Tasmania.

The eastern belt is by far the richest; it is most thickly populated, and has been most subdivided for political purposes.

Approaching the continent from Cape Town or Aden, we touch at *West Australia* first; from Singapore, by way of the *Java Sea*, *Queensland* is reached; from America or Cape Horn, *viâ* New Zealand, *Sydney* or *Melbourne*, the capitals of *New South Wales* and *Victoria* respectively, are the natural destinations.

It will be simplest to follow the order (*a*), (*b*), (*c*) suggested above.

(*a*) **WESTERN AUSTRALIA.**—This includes nearly the whole of the great arid plateau which fills the western half of the continent. This plateau is highest on its outer edge; little room is left for the development of a coastal plain. The plateau sinks to the great *sandy desert* in the region of the tropic and to the *chalk basin* of the Great Victoria Desert, around the shores of the *Great Australian Bight*.

The north-south extension of the colony is through 20° of latitude ($20 \times 69 = 1380$ mls.).

Drainage is by short streams from the highland rims of the plateau usually to the nearest point on the coast-line.

Climate and Productions.—*Rainfall* seldom penetrates to the interior. The principal rain-winds blow in from the west and the south-west; the *South-West Division* of the colony is well watered. In the rainy season, several lakes occur in the hollows of the southern half of the plateau.

The basins of the *Swan River* and the *Blackwood* receive most rain, and their rainfall reaches only 35 inches a year. This region is *forested*, and where the forests have been cleared *tillage* is well advanced. The principal timbers are *karri* and *jarrah*-wood. The *Huon pine* supplies the best timber for shipbuilding. *Fruits of Mediterranean type* can be profitably cultivated (latitudes are similar).

North of the Swan River basin, the coast-lands are *grassy* and suitable for sheep farms; *wool* is an important export.

Within the tropics, the northern section of the colony is rainy and supports *tropical forests* on the coastal plain.

Minerals.—The numerous *goldfields* of the colony are its chief source of wealth. These occur in the crystalline reefs of the tableland rim. They suffer from lack of water, especially when the upland lakes are dry. The more important fields have now railway communication with the coast. The *Kalgoorlie* and *Coolgardie* mines are the most important in the southern section. The various mining-centres of the region are served by a railway 600 miles in length, which finds outlets in *Perth* and *Albany*.

The *Yalgoo* and *Murchison* goldfields find their export-centre in *Geraldton*, *viâ* the northern railway, some miles south of the Murchison estuary.

The goldfields of the *North-West Division* are the *Ashburton* and *Pilbarra* mines, watered by the *Ashburton*, *Fortescue* and *De Grey* rivers. No railway exists at present.

Away to the north, and well within the tropics, is the tableland of the *Kimberley Division*, well watered by the *Fitzroy* and *Ord* rivers, on opposite flanks, with a valuable goldfield on the watershed.

A country of about one million square miles, it supports less than one-fifth of a million people. These are aggregated chiefly on the fertile strip along the coast of the *South-West Division*.

Towns and Communications.—A coastal railway links up the principal towns. The Eastern Goldfields Railway penetrates beyond Coolgardie to *Mount Morgan*.

Perth, the largest of these, has only about 50,000 inhabitants; twenty years ago it was a small town of 10,000 inhabitants. It has a fine observatory. *Fremantle*

is the port; its harbour is now available for large vessels, and P. and O. steamers make Fremantle a port-of-call.

Albany is a mail-packet station, but a mere village in population.

Gold is the staple export of the colony; *wool* comes second; *jarrah-wood* and *sandal-wood* are important.

The continental shelf awaits development as a *fishing ground;* the warmer shores of the northern section have important *pearl fisheries.*

The colony is yet young, first settled in 1829, it became a penal colony in 1850. During the last quarter of a century its progress has been rapid; the climate in the South Western Division is admirably suited to English folk.

(*b*) **SOUTH AUSTRALIA** forms the middle belt of the continent, and stretches from the south coast to the north. This was the *line of development;* hence the administrative name of the colony is retained, even though it includes some of the most northerly land on the continent. On its western edge it includes a portion of the western plateau of Australia; the crystalline *MacDonnell Range*, entirely within the colony of South Australia, is the highest part of the plateau.

The granite highlands of *Arnhem Land*, in the extreme north, repeat the characteristics of the Kimberley highlands. Instead of a sand desert or a chalky basin, South Australia is marked off from the other colonies by its large *inland basin*, the lakes of which are *salt*, like the *Caspian* and *Aral Seas* of *Eurasia.* They receive streams chiefly from the rainy region of the *Queensland highlands*, but evaporation is so excessive that no overflow takes place. Increasing saltness is the inevitable result. The contours of the regions and the geological features suggest that these lakes once formed *a chain of waters*, draining to the *Spencer Gulf.* The surface of *Lake Eyre* is, like that of the Caspian, reduced below sea-level. The principal feeders of this lake are the *Warburton*

River and *Cooper's Creek.* Intermittent waters come from the *MacDonnell Range.* Lakes *Gairdner* and *Torrens* are the next most important, though several occur.

The *salt fringe* of the lakes passes insensibly through *scrub-land* to grassy *steppes* in the upper plains of the rivers.

The axis of the *MacDonnell Highlands* is east and west; that of the *Flinders Range* is north and south. *Lake Torrens* lies in the basin on one side and *Lake Frome* on the other.

Lake Gairdner is similarly placed at the foot of the *Gawler Range.*

South Australia shares in the chalk waste of the *Millarbor Plain* along the *Australian Bight.*

The country around *Spencer Gulf*, the *Flinders Range*, southern extremity, and the lower reaches of the Murray recall the South Western Division of West Australia in climate, fertility and possibilities.

Strongly contrasted with this region is the tropic shoreland of the *Gulf of Carpentaria*, part of which belongs to South Australia.

Climate and Productions.—Rainfall varies from 25 inches in the south to almost *nil* in the interior; it increases as we penetrate the tropic belt until, on the shores of the Carpentaria Gulf, it reaches the annual total of 50 inches.

Tillage and *fruit-lands* in the south; *scrub* on the western highlands, *steppes* in the Eyre basin; *tropical forest* on the slopes of Arnhem Land make up the widely differing types of country included in this colony.

The *tropical forest* remains undeveloped; *wheat* is grown in sufficient quantities to allow of export to the other Australian colonies; *Port Pirie* is the chief wheat port in the colony; *wool* is a valuable export; *ostrich-farming* is proving profitable; timber and fruits of Mediterranean type (vine, olive, fig, etc.) thrive in South as in West Australia.

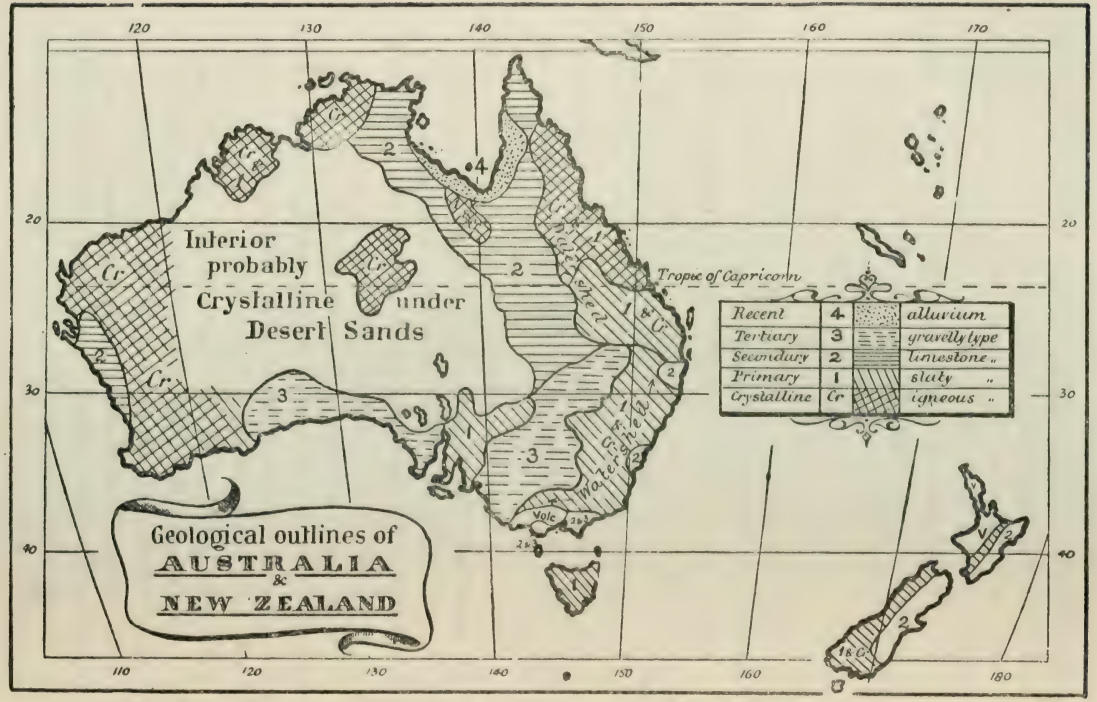


FIG. 326.- GEOLOGICAL OUTLINES OF AUSTRALIA AND NEW ZEALAND. (V=volcanic.)

Mineral Resources.—In mineral wealth, South Australia affords a contrast to its neighbours on both west and east.

Gold is practically absent—a little is mined in the northern territory.

Silver occurs in the region of Broken Hill, which mine is actually over the frontier in New South Wales.

The *copper* deposits of the Flinders Range are richer than those of any other colony on the continent.

Unlike West Australia, South Australia has almost ceased developing commercially; about equal to West Australia in area, it has twice the population. About 2,000 miles of state railways are in use. These link the mining centres with the capital (Adelaide) and the ports.

Spencer Gulf has *Port Lincoln*, *Port Augusta* and *Wallaroo*. *Wheat* and *copper* are the principal outgoing cargoes.

Adelaide, the metropolis of South Australia, has a fine harbour in *Port Adelaide*, on *St. Vincent Gulf*.

Gawler, just to the north, not near the range of the same name, is a *wheat* and *flour* exporting centre.

Following the railway northward, we touch *Kapunda* and *Kooringa*, important copper-mining centres. A branch strikes across the range, to serve the *Broken Hill* silver mines.

From *Port Augusta* a trunk line traverses the Eyre lake basin, and reaches *Oodnadatta*, north of the Stuart Range; it stops at the scrub belt which separates the Northern Territory from South Australia. This belt, so long the despair of explorers, was crossed by Stuart in 1861, and his route has since been marked by an *overland telegraph*, connecting north with south, and so, by means of ocean cables, with the East Indian Archipelago and our Indian Empire.

Palmerston, on *Port Darwin*, is the northern terminus of the overland telegraph and the focus of activity in the *Northern Territory*. It is connected by railway with the goldfields of the territory. *Tin* also occurs, but the mining resources await development.

(*c*) **QUEENSLAND** is the most northerly of the eastern colonies of the Commonwealth. It is more than twice as large as *New South Wales*, and has eight times the area of *Victoria*. Quite half the colony is within the tropics; the remainder nowhere trespasses six degrees beyond the Capricorn limit. The climate is therefore *practically tropic*. It is, however, modified by the *elevated character of the country* so as to be suitable to European colonists. Only the shores of the *Gulf of Carpentaria* are unhealthy.

The *East Australian Highlands* partake more of the character of a broad *cordillera* in Queensland than in the colonies further south, which share the *Dividing Range*.

The northern half, including the *Cape York Peninsula*, is mainly *crystalline* in rock-type; south of the Fitzroy River (and the tropic) Ancient Sedimentary rocks of *slaty* type predominate over crystalline schists and granitic cores.

Summer rainfall comes with the "monsoon" in January; it is very heavy. Winter rains drive in from the east, and are less copious. The annual rainfall is very considerable, exceeding that of any other colony on the continent. The *Cape York Peninsula* is the rainiest region; whilst the coast-lands average 50-60 ins., here the annual fall exceeds 80 ins.

The interior of the colony, draining to the Eyre lake basin, is a region of soft *Secondary Rocks*. Rainfall is low-averaging only some 20 ins. annually. The upland frontiers act as rain-barriers, both to north (*Selwyn Range*) and east (*Dividing Range*). Rivers are more plentiful than rainfall in the basin would suggest; their sources are back upon the cordillera.

South of latitude 20° S., the Dividing Range curves from near the coast at *Townsville* to the coast beyond *Brisbane*. This leaves room for the development of considerable river-basins, draining out to the east coast. Such basins occur in the other colonies, but are of much smaller dimensions. The largest of these in Queensland is the *Mackenzie Basin*.

which opens out to sea at *Rockhampton*, on the Tropic of Capricorn.

The upper courses of the *Warburton River*, *Cooper's Creek* and the *Warrego* (an important affluent of the Darling) are all within the Queensland interior.

A distinctive characteristic of the warm shallow seas on the east coast of Queensland is the *Barrier Reef*, built of coral rock upon the submerged platform, which runs out for forty or fifty miles from the shore. The coral organism requires warm clean sea-water in which to thrive; the gaps in the Barrier Reef are opposite the river mouths, at which *silt* and fresh water are poured into the sea.

The gaps in the barrier are thus conveniently opposite the estuaries, which are the seats of ports. The reefs terminate at *Capricorn Channel*, whose name indicates the latitude limit.

Productions.—Agriculture takes on more of a tropical character than in any other Australian colony.

Maize is more important than wheat; the *sugar-cane* is extensively grown; *cotton* is a crop on the coastal plains.

Pineapples and *bananas* are cultivated on the slopes; *tea* plantations are multiplying, especially on the York peninsula (*Cooktown*).

Sheep and *horses* are reared on the Darling Downs of the dry interior; *cattle* graze on the pasture lands along the coastal belt.

Artesian borings in the Secondary Basin of the interior are proving useful in counteracting the droughts to which Central Australia, shut out from oceanic influences, is peculiarly subject.

Mineral Wealth.—As in the colonies previously noticed, minerals are a valuable asset. *Gold* is the most important, and occurs in three distinct regions along the cordillera.

Charters Towers is the northern mining centre; it is joined to *Townsville* by rail.

The *Mount Morgan Goldfield* has its outlet and port in *Rockhampton*. The *Gympie Mines* can use *Maryborough* or *Brisbane* (capital), being linked by rail with both towns.

Copper deposits of considerable value occur at *Cloncurry*, on the ridge separating the Carpentaria depression from the interior basin (*see* Geological Map, Fig. 326).

Tin is a characteristic mineral of the Dividing Range, though not so plentiful as in the Malay Axis, which is the Asiatic counterpart.

Coal of Gondwana* type is found in those basins which open out to the eastern seaboard. Anthracite is being worked on the Dawson River. The *Mackenzie-Fitzroy Basin* is the most important coalfield. *Rockhampton* is the natural gateway.

The annual trade of the colony is sixty times that of South Australia. Much of it is with India, China and Canada (*viâ* Vancouver). Considerable interchange goes on with the colder colonies in the south of the continent.

The principal towns are ports; they have already been incidentally mentioned; from them railways strike to the mining uplands and the wool-collecting centres of the interior.

Hughenden, *Bercaldine*, *Longreach* and *Charleville* are live-stock market-centres. *Toowoomba*, on the Darling Downs behind Brisbane, is a great agricultural centre.

Brisbane is a city of 150,000 inhabitants; none of the others are more than a quarter its size. It is the governmental and administrative headquarters of the self-governing colony.

NEW SOUTH WALES is the oldest and the richest of the colonies of the Commonwealth; it was the *mother-colony* of the other colonies on the eastern seaboard and of New Zealand. From *Sydney*, the first settlement, colonists spread along the rich coastal belt and settled in the seaward-facing

* Gondwana-land is the ancient continent which formerly occupied the site of the present Indian Ocean.

FIG. 327.—THE SHEEP-LANDS OF AUSTRALIA.

[To face p. 679.

basins, which in this colony repeat the features of the larger basins on the Queensland seaboard. Later, colonists penetrated the gaps in the *Dividing Range*, especially by way of the *Hunter Valley*, between the *Liverpool Range* and the *Blue Mountains*. They emerged upon the *Liverpool plains* and found the well-watered basin of the *Darling*. This basin lies lower than the interior of Queensland; it is less subject to extremes and droughts; its rivers are more constant.

The frontier to the south is the *Murray*, which gathers up the waters of the rivers of New South Wales, and carries them to the sea. At the confluence, the *Darling*, which is the major stream of the colony, is of equal importance with the Murray, and has drained a larger basin. The *Lachlan* and its feeder, the *Murrumbidgee*, are important affluents of the Murray, coming from the plains of New South Wales. The *Dividing Range* is narrower and higher than in Queensland. It is less of a cordillera and more of a mountain range; its highest peaks, however, are only *1,500 feet higher than Ben Nevis*, and less than half the altitude of the Swiss Alps.

Resources.—Agriculture and mining features reproduce those of Queensland, except that grain and fruits differ with a cooler climate. No part of New South Wales is in the tropics. The average latitude is that of *California* or *Algeria*. *Mulberry trees*, *oranges*, *lemons*, *peaches*, *apricots* and other "Mediterranean" fruits thrive on the coastal farms.

Mining is of great importance, though gold-mining on the *Dividing Range* is of secondary importance to *silver*-working at *Broken Hill*, an isolated dome away on the western frontier of the Colony.

Coal occurs in the coast-basins, especially in the *Hunter Valley* and the fruitful *Illawarra basin*.

Tin and *copper* have minor importance in this colony. Mining and tillage are both less important than *sheep-farming* in New South Wales. The *Darling* and *Lachlan* regions of the interior are, of course, the regions for live-stock. *Cattle* and *horses*, whilst important, give place to *sheep*, which number scores of millions.

Wool is more important than *frozen meat* as an export; the annual export of merino wool approaches 10 millions sterling and makes up quite one-third of the total exports of the colony. *Tallow* and *Hides* are important.

Towns and Communication.—As in Queensland, the lines of communication are inward from the coast.

Sydney is the great port of the colony and the metropolis.

Newcastle is the coal-exporting centre, at the outlet of the *Hunter Valley*.

From *Sydney* railways radiate to all points of importance in the colony and to all the capitals of the eastern colonies.

Bourke, on the Darling, is the wool-collecting centre.

Broken Hill uses the ports of South Australia for shipping its silver ores.

Paramatta is a railway centre, just inland from Sydney.

Bathurst and *Goulburn* are mining centres on the Dividing Range.

Wagga Wagga is an agricultural market-town on the *Murrumbidgee*.

Grafton exports sugar and agricultural produce.

Wollongong is the chief outlet for dairy produce.

YICTORIA is the smallest of the mainland colonies of Australia. It is only about one-fourth the size of New South Wales, and only one-twelfth the size of West Australia. Yet its population approaches that of the former, and numbers six times as many as that of the latter.

It separated from the mother-colony in 1851, just after the "Gold rush." The *Murray River* serves as frontier. Whilst it retains the tripartite physical character of Queensland and New South Wales, it differs in many important respects.

The *Dividing Range* trends east-and-west; the angle of the range is in *Mount Kosciusko*, the culminating group in the whole range. Here the mountains take the ambitious name of the *Australian Alps*, though *Kosciusko* does not attain 8,000 feet. A carriage road has been cut to its summit.

Climate and Productions.—Rainfall comes from the west; both sides of the E.-W. range benefit about equally; of course, the Alps, owing to their height, receive the most copious rains.

The region between Adelaide and Portland is low, and here affords *access of oceanic influence into the Murray basin.* The interior of Victoria is thus more rainy and better watered than that of the other colonies. The southern flank of the Dividing Range west of Melbourne is a region of decayed *volcanic activity.* The volcanic soil, played upon by rain and disintegrating influences, is very fertile. It is on this soil that the *vineyards* of Victoria occur.

Wheat is an important crop, both in the interior and on the coastal belt. *Gippsland* is a *dairy-farming* country.

Wool is here, as in the other colonies, the staple export.

Gold has declined in recent years; *wine* and *butter*, from west and east respectively, are becoming important exports.

Towns and Communications.—*Melbourne* exceeds Sydney in population. It serves Victoria as Sydney serves New South Wales. It is capital, base of trade, seat of learning, and railway centre to the colony. It is four times the size of Brisbane.

As in the other colonies, the remaining towns are much smaller. *Ballarat*, the scene of the "Gold Rush," is only

one-tenth the size of Melbourne. *Sandhurst* (or *Bendigo*), the mining centre on the northern flanks of the Dividing Range, is still less. *Castlemaine* is another mining town.

Geelong is a small port subsidiary to Melbourne.

Portland serves the wine-producing district.

Mildura is a wool-collecting centre on the Murray. The outlet of the Murray is unimportant as a means of navigation.

Victoria has an average of latitude of 37° S. (=N. lat. of Sicily); it is cool for its latitude, owing to influences from the south-west.

It is a self-governing colony, and has two chambers of legislature. A governor is at the head of the executive. With slight differences, New South Wales is similarly governed. Together, they form the dominating units in the Federal Government of the Commonwealth. A proposal has been made to neutralise the rivalry of Sydney and Melbourne for first place in the Commonwealth by setting up a federal capital, *Dalgety*, on the frontier of the two colonies, about midway between the rival cities.

TASMANIA is the only member of the Commonwealth remaining to be considered.

Physically, it is an *outlier of the Australian Highlands*, the gap separating it from the mainland (*Bass Strait*) being submerged below sea-level. It reproduces the mountainous character of Victoria (eastern section). *Volcanic materials* occur; basalt-flows cover parts of the interior. Streams radiate to every shore. The island is built of *Primary rocks*. Long denudation by copious rains has resulted in *charming scenery* and *exceptional fertility*.

The mountainous interior is well wooded; the valleys and coastal fringe afford excellent pasturage and are adapted to fruit growing.

The *Derwent* and the *Tamar* are the principal rivers; they have the chief towns of the island on their estuaries.

Hobart, at the mouth of the Derwent, is the capital of the colony, and has a magnificent harbour.

The Tamar has *Launceston*, facing Bass Strait and looking across towards Melbourne, with which it is linked by cable.

The annual average temperature is similar to that of Great Britain; range is low, for whilst summers are only slightly warmer, the winters are much more genial than those of the home country.

Tasmania has a latitude similar to that of the south of France; *wheat*, *wine* and *fruit* are important exports.

Tin and *gold* are extensively mined, but tin is a more valuable asset than gold.

The island is not without *coal*, and ores of almost every metal are found.

The mines are chiefly in the N.E. and N.W. corners of the island.

A railway ascends the *Tamar Valley* from *Launceston* and descends to *Hobart*. A branch strikes westward, past the *copper-mining region of Mount Lyell*, to *Port Macquarie*.

A short line links the *Bischoff tin mines*, in the N.W. of the island, with *Emu Bay*, the point of export.

Tasmania has several off-lying islands. The colony is *self-governing* and a member of the Australian Commonwealth.

The S.E. section of the large island of **New Guinea** is also British. It is under the control of the Australian Federal Government. *Pearl-fishing* is the principal occupation of the natives, who form practically the entire population.

Port Moresby is the chief trading centre.

CHAPTER VII.

Our Colony at the Antipodes: The Dominion of New Zealand.

New Zealand is best treated apart from Australia. An ocean *twelve hundred miles wide* separates the two countries. The most *northerly* point of New Zealand is only in the latitude of Sydney; the most *southerly* point is 10° nearer the South Pole than Melbourne. Politically, they are separate, though New Zealand is an offshoot from New South Wales; New Zealand stands outside the Commonwealth of Australia.

The three islands which make up the colony are parts of *one continuous mountain wall. Cook Strait* and *Foveaux Strait* are submerged gaps in the range. Little room is left for the development of inland basins. A broad belt occurs in the *Canterbury Plain*, on the east coast of South Island.

A *volcanic basin* occupies the angle between the forked ranges of North Island. The mountain wall is highest on the *west* of South Island and on the *east* of North Island. The mountains of South Island attain in *Mount Cook* an altitude of over 12,000 feet. They present a steep wall to the ocean on the west, and the south-western section of the coast of South Island includes some magnificent *fiords*.

Rain-winds blow in from the west and south-west. As a result, the western flanks of the islands are wetter than the eastern slopes. The *Southern Alps* form a striking rain-barrier; rainfall is twice as heavy in the fiord region as it

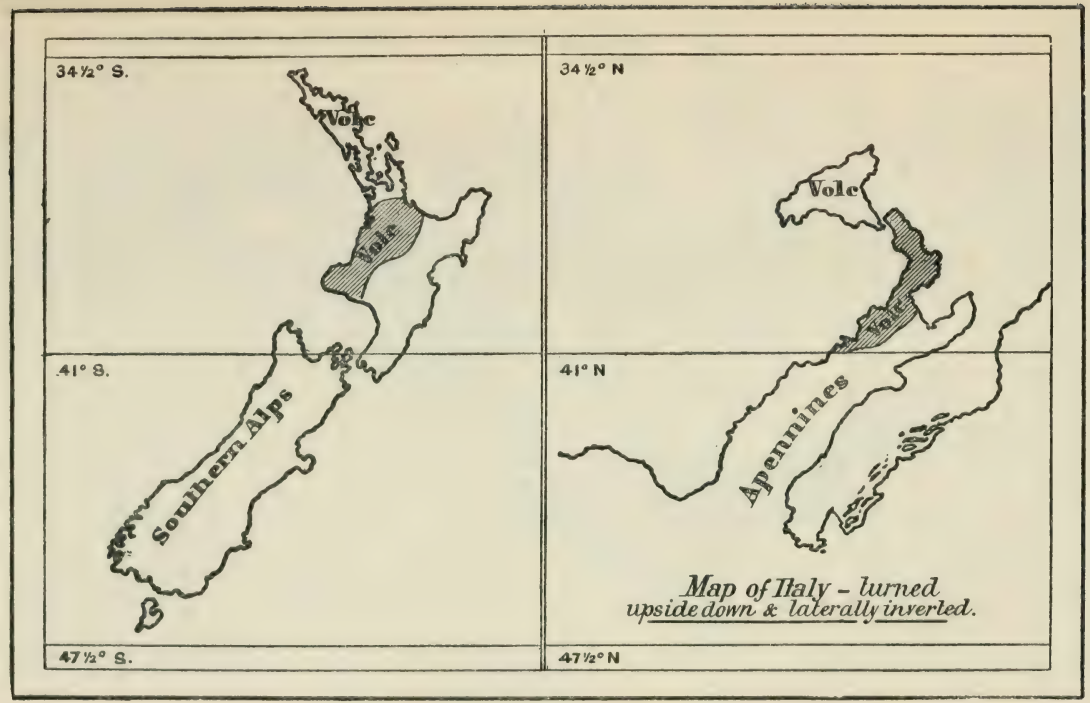


FIG. 328.—NEW ZEALAND AND ITALY—A COMPARISON.

is on the *Canterbury Plains*. *North Island* is less rainy than *South Island*. But nowhere is the land so shut off from rain sources as in the drought-frequented interior of Australia.

North Island, being warmer, differs in agricultural development from *South Island*.

Minerals are of secondary importance in New Zealand.

Timber, *wool* and *gum* are the principal exports.

Frozen mutton, *gold*, *dairy produce* and *flax* are also exported. Fig. 328 brings out a curious comparison between New Zealand and Italy.

Latitudes, *ranges of mountains* and *volcanic districts* afford a striking comparison. The climate of New Zealand is slightly more *equable* than that of Italy, because New Zealand is surrounded by an ocean.

The colony of *New Zealand* separated from *New South Wales* in 1841. It has been self-governing since 1852. *Auckland* was the first capital, but *Wellington*, more centrally placed, was substituted in 1865. Parliament consists of an upper and a lower House, with *Maori* representatives in both. A governor presides over the Executive. The colony became the "Dominion" of New Zealand in 1907.

North Island is remarkable for its *volcanic basin*. Volcanic activity is by no means extinct. A violent eruption of *Tarawera* took place in 1882. The famous eruption of Tarawera, in the Javanese group, followed soon after. The triple-coned, *Tongariro* and *Ruapehu* are still active. Hot springs are numerous. *Lake Tauno* is in the centre of the basin; its waters are cold, they drain by the *River Waikato* to a point on the coast not far from Auckland. A low range of folded mountains separates the volcanic basin from the eastern coastal belt. *Mount Egmont* is a massive extinct volcano, marking the southern limit of the volcanic region.

The island is well wooded; *kauri pine* is the principal timber, and *kauri gum* is quite an important export. *Sheep*

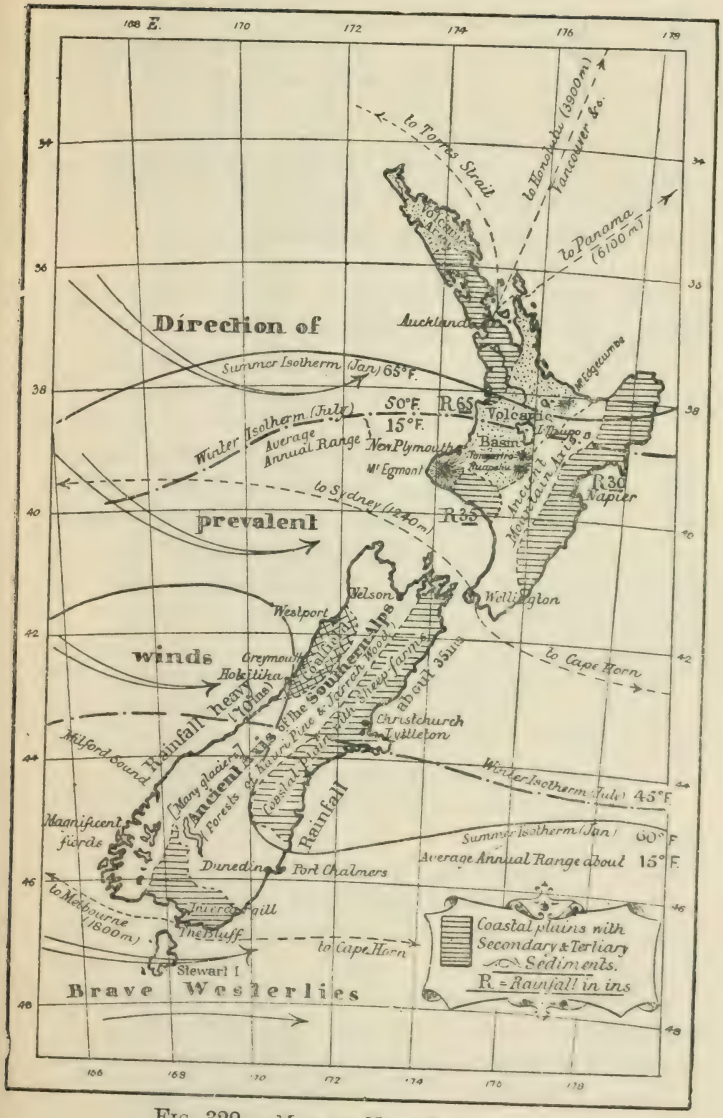


FIG. 329.—MAP OF NEW ZEALAND.

are fewer in the North Island than in the South. The coastal strips are very fertile. *Napier* on *Hawke Bay* is the focus of the eastern belt. *Auckland* is in the middle of another fertile strip. It is the largest town in the colony (85,000 appx.) *Wellington*, the capital of the colony, is rather less like Auckland; it is an important shipping centre, though less important as a point on the trade routes. The remaining Maoris are chiefly found in the North Island.

South Island is larger and richer than North Island. The *Southern Alps* attain Alpine characters in the south, even to the possession of *icefields*, *glaciers* and *ribbon lakes*. *Tasman* glacier is larger than the great Aletsch glacier of the Alps. The mountain barrier makes access between east and west difficult. The coastal plain is chiefly on the east; a fertile basin penetrates the island from the southernmost point. A basin on the abrupt western flank is filled with *coal deposits*. A railway serves the basin, linking up the ports of *Hokitika* and *Greymouth*, but it has not yet pushed through the range to serve the *Canterbury Plains* immediately opposite on the other side.

These plains are the richest region in South Island. *Christchurch* is the trade centre, and *Port Lyttleton* the shipping-gate. From the slopes come *kauri pine* and *jarrah wood*; from the plains are exported *wool* and *meat* and *butter*.

Port Nelson is the port of the north, and is linked by cable with Sydney.

Banks Peninsula is of volcanic origin.

The southern valleys find their outlet in *Invercargill*, whose *bluff* is a port-of-call for steamers taking the Cape Horn route.

Dunedin and *Port Chalmers* are respectively market centre and port for the mountainous region of the south-east.

Milford Sound is the finest of the fiords on the west coast.

Stewart Island is an outlier of the Southern Alps.

The scattered groups of islands on the submarine platform to the west and south belong, politically, to New Zealand. The chief are Chatham, Auckland, and Kermadec Islands.

Outlying Colonies.—Of the island groups of the Southern Pacific north of New Zealand the following are British:—

The *Solomon Isles* and the *New Hebrides;*
The *Fiji Islands* and the *Tonga Group.*

Several less important groups are British possessions.

The island groups are either *volcanoes* or *coral-covered volcanic stumps.* They yield the usual tropical produce—*cabinet-woods, rice, sago, cotton, sugar, rubber* and *oil, tobacco* and *spices.*

The **Fiji** and **Tonga** groups are the most important. Although only 20° S. of the Equator, they are habitable by Europeans, owing to their *equable climate.*

Suva is the capital of the Fiji group. The Fiji harbours serve as ports-of-call for steamers between *Vancouver* and *San Francisco* on the American Pacific seaboard and the Australian and New Zealand seaports on the Southern Ocean. The groups are formed into Crown Colonies.

GEOGRAPHY OF AFRICA.

CHAPTER I.

World Position, Dimensions, Broad Outlines of Physical Features and Geological Structure.

[Maps to be used: Terrestrial Globe; Mercator's Map of the World; Africa (orographical*), and Africa (geological†).]

World Position.—The "dark" continent of Africa, now so rapidly being partitioned among the Great Powers of Europe, is the most tropical of all the continents. The *Equator bisects the continent*, crossing the Congo Basin and the sources of the Nile. North of the Equator, the long axis of the continent is east-and-west and of a length equal to the longest E.-W. line in Europe. South of the Equator, the axis is north-and-south, and similar in length. Africa stretches through *70 degrees of latitude*, yet no part of it has a colder temperature, even in winter, than the summer temperature (average) of the British Isles. The coldest north is as warm as the Medi-

* Published by Geo. Philip and Son, 32, Fleet Street: 2d.
† Outline map given on page 697.

terranean, the coldest south is as genial as Australia. The continent lies due south of Europe, separated by the deep cleft of the Mediterranean. Its most easterly point (C. Guardafui) does not lie further east than the frontier of Europe in the Urals and the Caspian Sea. It is cut off from Asia by the sea-filled sunken trough of the Red Sea. Its most westerly point, C. Verde, in the latitude of Madras and Barbados (West Indies), lies nearly 20° W. of London and in the *average* longitude of Iceland. Africa is about three times the size of Europe, and two-thirds the size of Asia.

It differs from these continents of the Old World in the simplicity of its coast-line and its extreme poverty in harbours. The *two great foci* of trade and communication are *Cairo* in the north and *Cape Town* in the south, and yet Cairo is at the head of a delta on an inland sea, and Cape Town has a naturally ill-protected harbour. The Cape was originally called the "Cape of Storms." A distance of 5,700 miles lies between these two cities, sooner or later to be linked by through trans-continental communication—a line of transit which will equal in importance the C.P.R. or the Trans-Siberian Railway.

Islands.—The large island of Madagascar (a possession of France) stands on a submerged continental-shelf projecting out into the Indian Ocean from the South African coast. Madeira, the Canaries, and the C. Verde Islands are solitary peaks rising from a similar *shelf* projecting from the North-West African coast. The British Islands of Ascension and St. Helena are true *oceanic islands* rising from the submarine ridge which runs midway along nearly the entire length of the Atlantic. The Seychelles and Mauritius, both British possessions in the Indian Ocean, rise from a submerged platform linked with that of Madagascar. Such islands are usually the summits of volcanoes thrown up on these sunken shelves, and the islands mentioned are no exceptions. The

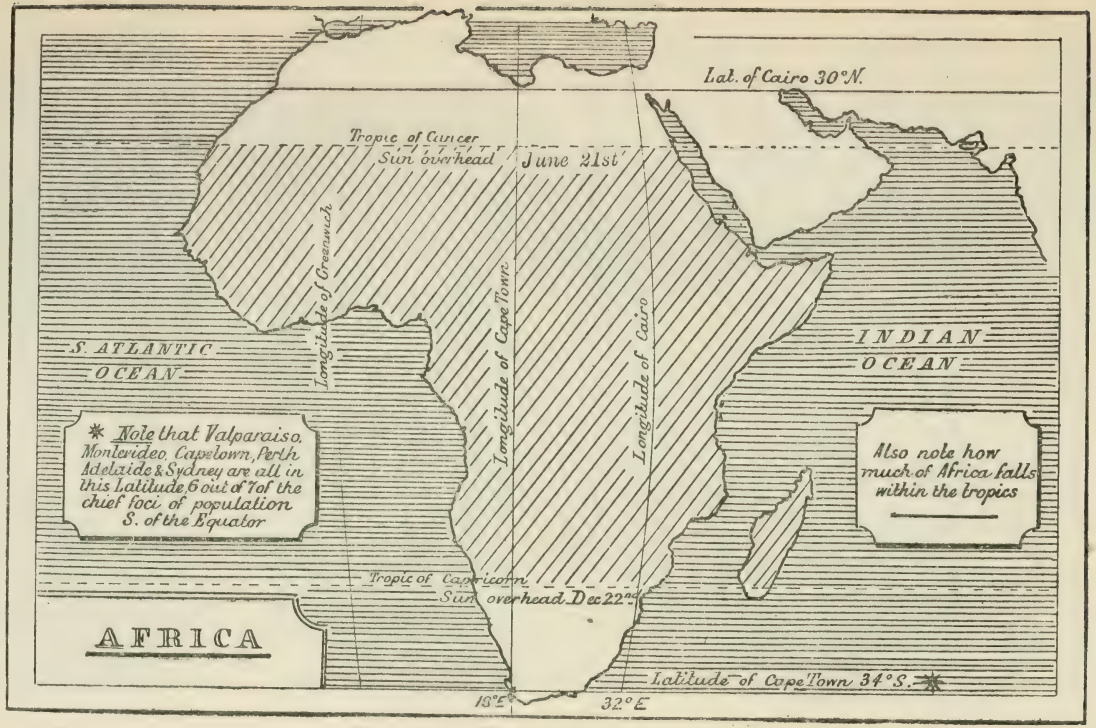

Lat. of Cairo 30°N.
Tropic of Cancer
Sun overhead June 21st
Longitude of Greenwich
Longitude of Cape Town
Longitude of Cairo
S. ATLANTIC OCEAN
INDIAN OCEAN
* Note that Valparaiso, Montevideo, Capetown, Perth Adelaide & Sydney are all in this Latitude, 6 out of 7 of the chief foci of population S. of the Equator
Also note how much of Africa falls within the tropics
Tropic of Capricorn
Sun overhead Dec 22nd
AFRICA
Latitude of Cape Town 34° S.
18° E
32° E

FIG. 330.—WORLD POSITION OF AFRICA.

great value of these islands lies in their use as *ports-of-call* for water, coal and provisions. All the islands mentioned are so used.

Structure of the Continent.—In general build, Africa resembles Asia and Australia rather than Europe and North America. It is a continent in which plateaux and broad basins, hemmed in by the edges of plateaux, predominate over folded ranges and parallel stream-systems. The rivers creep round the edges of the table-lands in an almost semi-circular course to the sea. They reach the ocean by breaking through fractures or gaps in the rims of the plateaux. Such, for example, is the case with the Niger and the Congo in Tropical Africa, the Zambesi and the Orange in South Africa. The tilt of the blocks is alternately east and west, with the resulting alternate flow of the rivers (Congo and Zambesi, Limpopo and Orange).

The great exception is the Nile, whose course is a zig-zag one along a line of longitude. It is, perhaps, the finest example of a rift-valley the world affords. If we continue our observation northward into Palestine and southward into the lake region of Central Africa, we notice the tendency of streams and lakes to lie in a north and south direction. All points to a series of fractures giving rift-valleys, more or less parallel since they owe themselves to common disturbances. The river in its flow gains access from one rift to another in its descent to the plain, whilst on the whole the direction of flow is constant.

It is remarkable that to the east of this line of fractures we have the highest ranges in the continent. The Abyssinian heights and the volcanic ranges of British East-Central Africa run in the same general direction as the depressions. Moreover, in these two ranges east of the Nile rift-valley, volcanoes of prodigious height occur. Mount Kenia, on the Equator (yet snow-capped), and Kilima-Njaro, on the frontier dividing

British and German territory, both rise more than 17,000 feet above sea-level (*cf.* Mont Blanc, 15,780 feet).

The orographical map shows that the eastern and southern sections of the continent attain a considerably higher average elevation than their western and northern counterparts. The higher rim of each block of table-land lies parallel to and near the coast, the blocks slope to a point somewhere in the interior, with the result that many streams coalesce to form one large river. Outside the plateaux-rims there occurs a narrow strip of coastal plain—hot, damp, unhealthy and exceedingly fertile. If the coastal ridges are high, and placed normally to the rain winds, the character of the interior is considerably modified. The coastal strip widens along the Mediterranean east of the Atlas Range, and *here*, in *temperate* regions, it is *healthy*. It is fairly broad in the Gambia district and around the Gulf of Guinea, as also at the delta of the Zambesi. But these areas in *tropical* latitudes are most *unhealthy*.

The Atlas Range, which fills the projection of Africa from the Desert of Sahara, is the truest mountain-range or folded-system in Africa. It occupies the two countries of Morocco and Algeria, which show a striking contrast to the barren interior. The central range is of ancient crystalline rocks upthrusted in the folding process, and on either flank lie folds of successively younger rocks—as in the Alps of Switzerland. Indeed, structurally, the Atlas system belongs to Europe rather than to Africa.

GEOLOGICAL FEATURES.—The ancient crystalline rocks which form the foundation of the continent seem broken up into *blocks*, some elevated, some depressed, others tilted. The result is *polygonal basins* and fracture-bounded plateaux. Sediments, whether of Primary or Secondary age, lie successively upon each other, either like saucer-within-saucer in the basins or as layer-upon-layer on the table-lands. The

two types of geological formation—basins and plateaux—may be illustrated by diagrammatic sections.

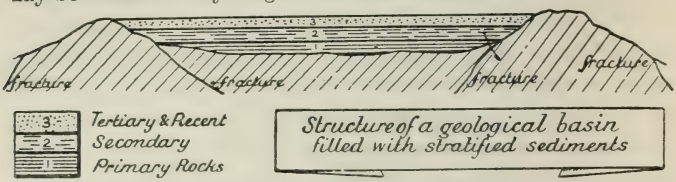


FIG. 331.—STRUCTURE OF A GEOLOGICAL BASIN FILLED WITH STRATIFIED SEDIMENTS.

Crystalline Rocks.—The rims of these saucer-like depressions, which are likewise the boundary ledges of table-lands, are, in Africa, nearly always of crystalline rocks. The

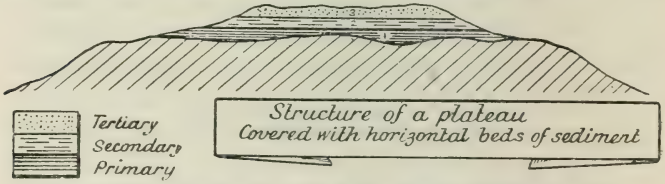


FIG. 332.—STRUCTURE OF A PLATEAU COVERED WITH HORIZONTAL BEDS OF SEDIMENT.

accompanying map (Fig. 333) shows how many of these ridges lie near the coast-line and determine the general shape of the continent. On the east the line is further back from the coast, but there is every reason to believe that in the early physical history of the continent the coast-line was in close proximity to the foot of these, the highest table-lands.

Primary Rocks.—The oldest sediments will lie next the crystalline foundation on which they rest. Often, and especially in basins, they lie buried under younger deposits. When they emerge it is usually along the flanks of the rim-ranges, and in deep ravines like that of the Zambesi. Primary rocks appear to underlie the sands of Sahara—for, in many places, wind-swept patches of Primary rocks occur. Along the long line of table-lands stretching from the Red Sea to the Cape, Primary rocks emerge, and yield coal and iron in the uppermost layers.

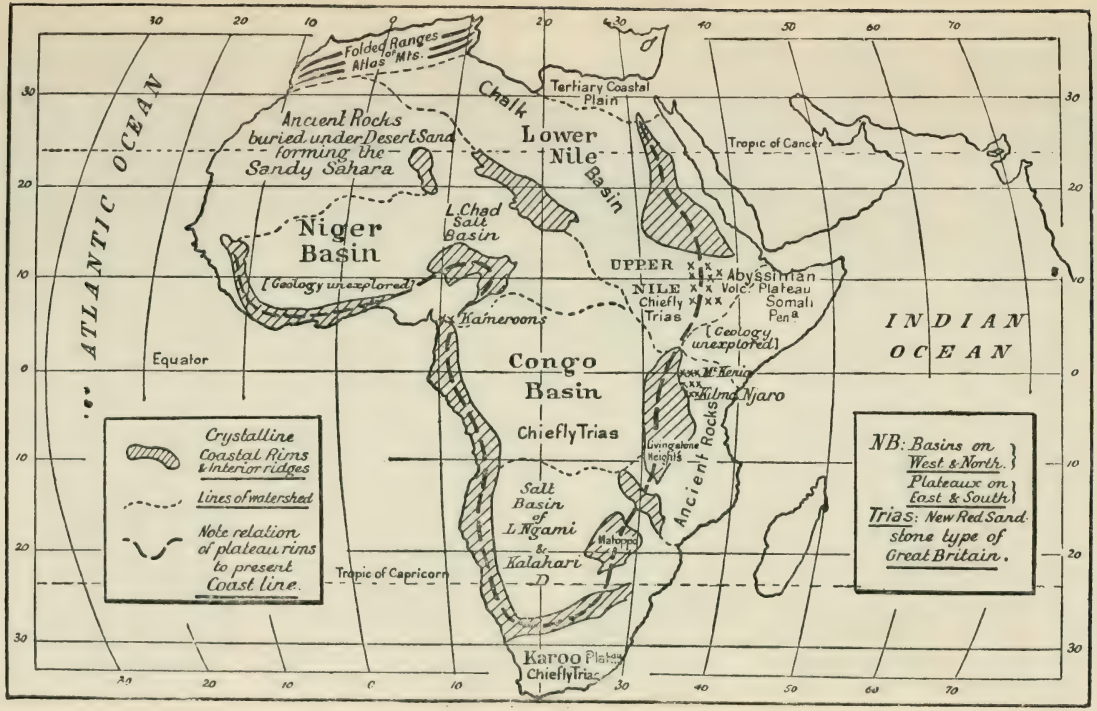


FIG. 333.—GEOLOGICAL STRUCTURE OF AFRICA.

Secondary Rocks.—The Secondary rocks are well represented in Africa, and especially the oldest type of Secondary rocks, comparable to our English New Red Sandstone and that upper half of it which goes by the German name of *Trias*, owing to its being made up of three distinct facies of rock. Coal seams occur at the base.

The basins of the *Orange*, the *Zambesi*, the *Niger* and the *Upper Nile* are Trias-filled basins. Moreover, since Triassic times no additional sediments have been laid down except alluvial matter and lake deposits.

The Libyan Basin and the Lower Nile Valley, on the other hand, are characterised by deposits, chalk upon sand-

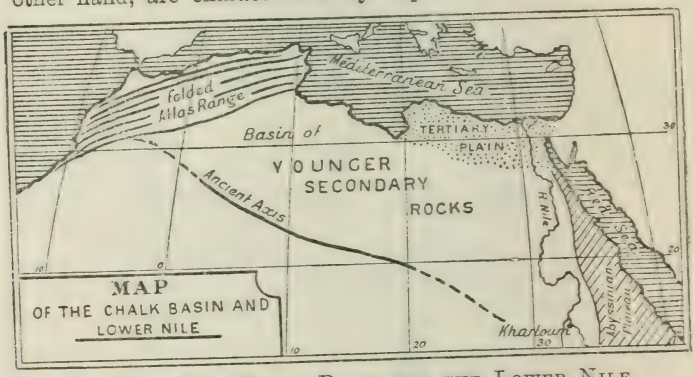


FIG. 334.—THE CHALK BASIN AND THE LOWER NILE.

stone (Nubian sandstone), equivalent in age to the Wold and Weald Rocks of England.

Tertiary Rocks.—As usual in all the continents, Tertiary *unconsolidated* sediments and *soft* limestones cover the coastal plains. They peep through where the Sahara sands approach the Atlantic; they cover the plain along the west coast of Madagascar; they are especially well seen along the Mediterranean from Bengazi to the Red Sea.

Recent or *Quaternary* sands cover the Sahara and the Kalahari desert regions. The deltas and basin-bottoms of

many of the great rivers are made up of alluvial deposits, laid down where the river meets the sea or where innumerable streams coalesce and in rainy seasons flood the plain. Such deposits lie upon the Trias basins of the Congo and the Upper Nile.

Volcanic Plateaux.—Volcanoes are usually associated with fracture-lines and sea-margins, and in Africa we have no exception to the general rule. The volcanoes are to be found on the seaward side of the block plateaux or on the outlying oceanic islands, which follow roughly a parallel trend to the continental coast-line.

Madeira, C. Verde Islands, Ascension, St. Helena and Tristan d'Acunha are extinct volcanoes on the Atlantic submarine ridge. Vulcanism is not yet extinct in the Teneriffe group. The coastal island of Fernando Po and the mountain of Kamerun (or Kameroon) on the mainland opposite are foci of former volcanic disturbance.

It is along the eastern border of Africa, however, that volcanic phenomena on the grandest scale have occurred. The ancient crystalline plateau of *Abyssinia*, between the Upper Nile and the Red Sea sunken-trough, the gathering-ground of the chief tributaries of the Nile (Atbara and Blue Nile), is covered with volcanic outpourings and débris. The Italian colony of Eritrea and French Somaliland are within the area. Even Aden and Perim, British possessions on the Arabian side of the sea-trough, belong to the same volcanic region.

Due south of this plateau is the volcanic plateau of British East Africa with the giant piles of *Kenia* and *Kilima-Njaro*, both over 17,000 feet high, the former on the Equator, yet snow-capped in a country where snow is never seen to fall, the latter rising as a double cone on the Brito-Germanic frontier.

The eastern half of the island of Madagascar is another crystalline mass with numerous volcanoes.

Traces of lava-flows are found in the Zambesi gorge, and débris of volcanoes occurs among the crystallines of the Sahara interior.

The Niger Basin the Congo Basin, and the South African tabular plateau seem rather deficient in volcanic features.

Deserts and Salt Basins.—If Africa is deficient in mountain back-bones like the Rockies, the Andes, the Alps and the Himalayas, it still can show features shared to no great extent by any continent except Australia. And when the student comes to the study of Australia, he cannot fail to be struck by the many analogies of structure which the two continents present. Even more striking is the similarity existing between Africa south of the Zambesi and the island-continent.

Sahara is the premier desert. The Kalahari waste of South Africa reproduces its physical features under similar conditions of latitude. Associated with each rainless desert is a salt basin fed by scanty rainfall. Evaporation keeps pace with downpour so that no rivers are required to carry off the surplus waters. At times of great heat and evaporation, or (on the other hand) of drought, the lakes shrink to mere pools. Lakes which have no outflow are salt in nature, owing to evaporation leaving behind the salts brought by river-inflow. The disappearance of a lake leaves an incrustation of salt. Lake Chad in the Sahara region and Lake Ngami in the Kalahari desert are the chief salt lakes in Africa. The waters of Lake Chad are only slightly brackish.

CHAPTER II.

Climatic Conditions, and their Effect on Vegetation and Agriculture.

[Maps to be studied: Orographical Map of Africa; Isothermal Maps of Africa for January and July; Rainfall Map; Map Showing Zones of Vegetation; Map of Productions.]

AFRICA is the most tropical of the continents; only the *Mediterranean Border* and *South Africa beyond the Limpopo* lie outside the Torrid belt. The temperature of the rest of the continent—quite *three-fourths* of the whole—averages 80° F. all the year round, never rising much above 90° F. or falling below 70° F. The average for the British Isles is 30° F. *lower*, as also are the maximum temperatures for summer and winter. In Central Africa *seasons are not marked off* from one another as are those of Temperate and Arctic latitudes. The only seasons recognisable are the *wet* and the *dry*, determined by conditions of rainfall and not by the angle of incidence of the sun's rays.

Where Africa is broadest—*i.e.*, between the Equator and 10° N. Lat.—the difference between summer and winter is not more than 5° F.—a minimum of difference not surpassed by the oceanic islands of the mid-Pacific.

Poles of Heat.—Whilst the Equatorial belt has the highest average temperature, it does not give the maximum temperatures of the continent. In July, when the sun is overhead in the region of the Tropic of Cancer, the maximum of heat on

the continent is experienced *where 20° E. Long. intersects 20° N. Lat.*; and places just south of the Atlas range (33°-35° from the Equator and 10°-12° *outside* the tropics) are *hotter* than the Equatorial belt.

The same is true of the southern peninsula. The Zambesi region—especially near the Victoria Falls—is hotter in January,

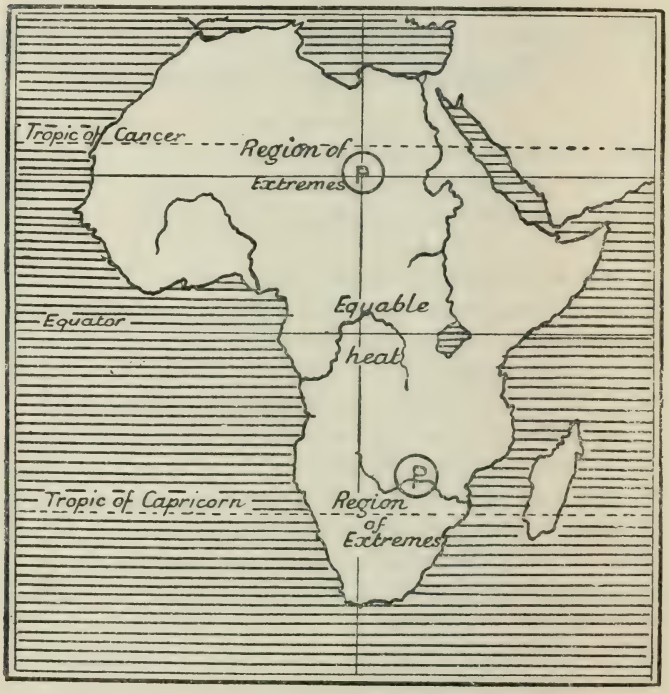


FIG. 335.—POLES OF HEAT.

when the sun is overhead in the region of the Capricorn tropic, than the Congo Basin and Victoria Nyanza, which lie upon the Equator.

But these intensely hot areas of Africa actually become the coldest regions in their respective winter seasons. The poles

of greatest cold do not quite coincide with those of greatest heat—Nature does not admit of such simple variations; the cold pole of the northern region (January isotherm 56° F., or 16° F. warmer than the British Isles) falls on the middle of the Mediterranean sea-board. That of the southern region—again 56° F. in July, the South African winter month—falls at Cape Town, in both cases *farthest* from the tropic. The greatest variation between winter and summer is experienced in Mid-Sahara and on the upland basin of the Limpopo.

Tropics and Equator.—It will be noticed that these *extremes* are associated with the tropic boundaries, whilst the *equable* region falls in equatorial latitudes.

The regions of **Cancer** and the regions of **Capricorn** have a

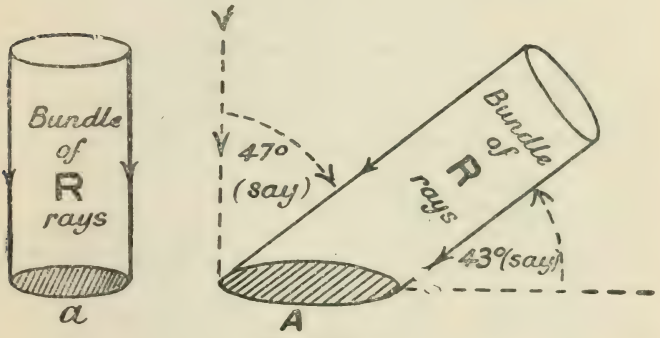


FIG. 336.

[Diagram to illustrate loss of heating-effect with obliquity of rays. The same number of rays (R) falls upon the small area (*a*) as upon the much larger area (A), hence (*a*) becomes much more heated per unit area than (A).]

maximum difference of altitude of summer and winter suns. On the *mid-summer day* in each case the sun is overhead, on the *mid-winter day* the sun is 47° (*i.e.*, $23\frac{1}{2}° \times 2$ = latitude-distance the tropics are apart) away from the zenith, and therefore (90° − 47°), *i.e.*, only 43° above the horizon.

For the **Equator,** however, the sun is never more than $23\frac{1}{2}°$ from the zenith, whether in December or June, and so small an angle from the vertical makes far less difference (*see* Fig. 336)

in proportion of heating power than for a distance of 47° from the zenith. Moreover, in January and July the altitude is the same in both cases, viz., *about* $23\frac{1}{2}°$ from the vertical; it is in March and September that the sun is overhead.

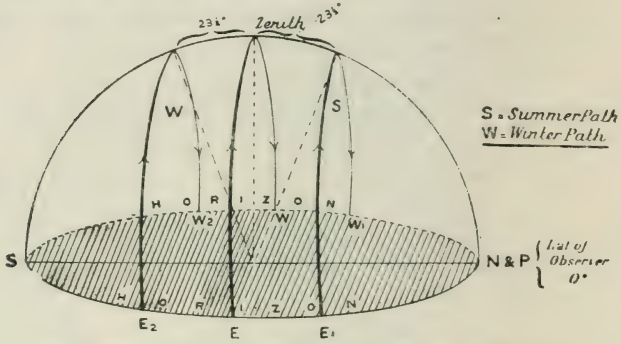


FIG. 337.—CASE OF OBSERVER AT THE EQUATOR.

E_1W_1 = path of sun across the sky on June 21st.
E W = " " " Sept. 23rd and March 21st.
E_2W_2 = " " " December 22nd.

Note similarity for *June* and *December* (S. and W.).

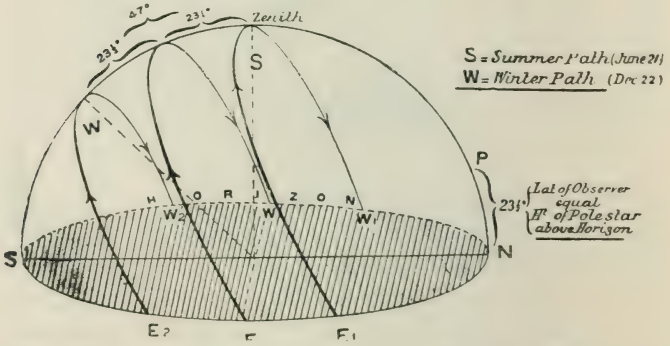


FIG. 338.—CASE OF OBSERVER AT THE TROPIC OF CANCER.

E_1W_1 = path of sun across the sky on June 21st.
E W = " " " Sept. 23rd and March 21st.
E_2W_2 = " " " December 22nd.

Note *dissimilarity* for *June* and *December* (S. and W.).

[The student should draw the diagram for the *Tropic of Capricorn.*]

Comparing the Tropic Lines with the Equator we get :—

Cancer and Capricorn.	Equator.
1. Days vary considerably in length between summer and winter.	1. Days do not vary in length.
2. Obliquity of rays varies as much as 47° between summer and winter.	2. Obliquity of rays varies only 23½°.

If we add to these the fact that rainfall is heavier at the Equator than on the Tropic Lines (in Africa) we get, in the one case (tropic-lines) three facts all tending to give extremes between summer and winter, and in the other case (Equator) three facts all tending to equalise summer and winter temperatures.

Effect of Rainfall.—But the chief *equalising agent* between summer and winter is the *rainfall*. A glance at the Rainfall Map reveals the striking fact, already noticed in other continents, but more pronounced in Africa than anywhere, that *sparse* rainfall allows full development of summer and winter extremes, whilst *dense* rainfall modifies both winter and summer extremes, reducing the range of temperature to a minimum.

The inset map (Fig. 339) shows that North and Central Africa receive their rain from the *Atlantic*, whilst South Africa on the whole derives its rain from the *Indian Ocean*. Minor variations will be noted in dealing with the separate geographical units of the continent.

The rainfall in each case diminishes as we traverse the continent from the ocean-source. The *Atlas-barrier* effectively taps the rain-winds of the North Atlantic, giving a sudden decrease on the interior rain-shadow side of the range, and bringing in almost immediately desert conditions. The fall from Madagascar to the Kalahari is almost as great, though *more gradual*, since an altitude equal to that of the Atlas is nowhere reached.

In the tropics, rainfall decreases rapidly behind the Kong Mountains, but steadily along the Equatorial belt and *proportionately with distance* from the rain-source, owing to

the absence of any rain-barrier in the form of a mountain-wall set normally to the moist winds. A study of all the physical conditions on the continent of Africa leads to the conclusion that it is most conveniently divided up into climatic *belts* rather than *provinces*; in the **north,** where the axis of the

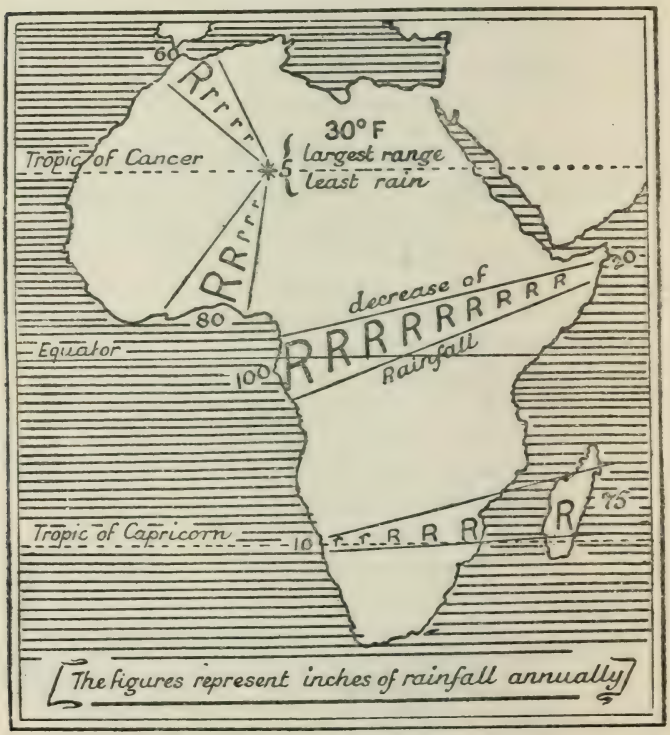


FIG. 339.—AFRICAN RAINFALL.

continent is along a line of latitude, the belts run roughly *parallel* to belts of latitude and therefore parallel to the Equator; in the **south,** the belts tend more to bend themselves parallel to the *margin* of the continent. No great arms of the

sea penetrate to cut up the continent into peninsulas and give, as in Europe, a complicated system of isotherms, indicative of a great variety of climatic provinces. We may roughly tabulate the **climatic units of Africa** as follows :—

1. *The Mediterranean Border.*
   (*a*) The Atlas ranges ; (*b*) The Egyptian coastal plain.
2. *The Desert Belt.*
   (*a*) The Sahara; (*b*) Libya and the Red Sea.
3. *The Soudan* (or *Sudan*).
   (*a*) The Nigerian interior; (*b*) Egyptian Soudan.
4. *The Tropic Lands.*
   (*a*) The Guinea Coast; (*b*) The Congo Basin; (*c*) East Africa.
5. *Africa south of the Zambesi.*
   (*a*) The Kalahari and Ngami region; (*b*) The Veld; (*c*) The coastal fringe.

VEGETATION and AGRICULTURE. — In Africa, and especially in the tropics, heat is everywhere sufficient to allow of production and to encourage cultivation. **Rain** is the **determining factor**, and the vegetation-provinces coincide very markedly with the varying densities of rainfall. Dense *tropical forest* with undergrowth characterises the heavy rain regions (60-100 ins.). *Savannah* grasslands with open forests cover the lands with medium rainfall. *Scrub*, with yellow grass and cacti, fringes the bare deserts and indicates a sparse and uncertain supply of rain.

The rainless regions (or those with less than 5 ins. annually), dry mountain-walled interiors parched under a tropic sun, give vegetation around oases only. *Oases* are points at which the rainfall of the desert borders, after percolating the sands and much-fractured crystalline floor of the basin, emerges as spring-water, and creates a veritable garden in the sand-waste. The student has only to compare the inset maps (Figs. 339, 340) to note the bearing of rainfall on types of vegetation.

Five distinct types of vegetation are recognisable, though, of course, in any district the change from one type to the other is generally *transitional*. Sudden changes accompany sudden changes of climate, as is the case on the opposite sides of a rain barrier (*e.g.*, the Atlas). The coastal strip, here broad and there narrow, is usually very fertile and very damp. Under the

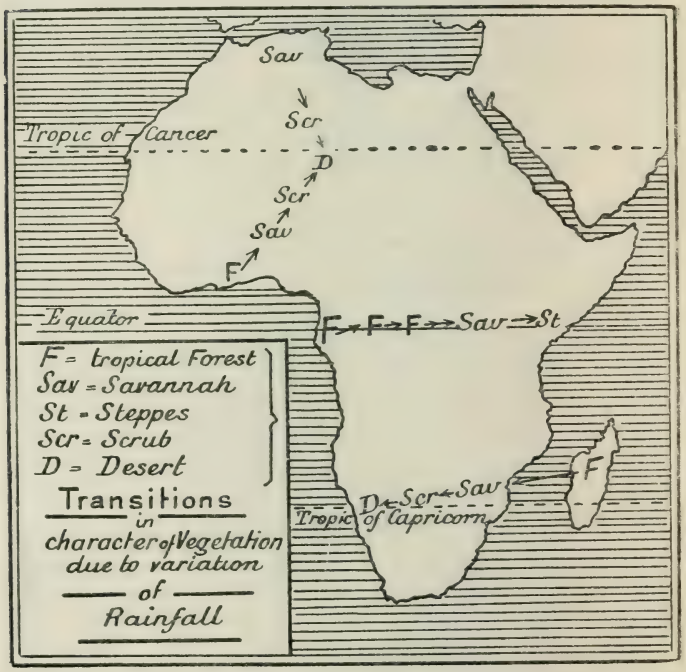


FIG. 340.—TRANSITIONS IN VEGETATION

tropic sun it is also very unhealthy, owing to swamps, whose warm waters develop disease germs. The removal of these swamps by drainage—at the instance of Dr. Ronald Ross—is making the coastal plains, so long considered the "white man's grave," much more habitable to Europeans.

Vegetation Provinces.—We should not be far from the

facts if we used the same divisions for vegetation-units that we have taken as climatic-units on *p.* 707.

The **dense tropical forests** have been well described by Stanley. Luxuriant forest trees, accompanied by dense undergrowth, swampy soil, profusion of vegetable and animal life, are found in the very rainy regions. The Negro race occupies this zone of the continent, the Soudan Negro being found north of the Equator, and the Bantu, a higher type, south of the Equator. Village communicates with village by footpath cleared in the undergrowth. Transport is by means of porters, who carry the packages upon their heads to keep clear of encumbrance. The *banana* is the chief article of food. *Rice* can be cultivated on the river banks. *Coffee* shrubs thrive on the drier slopes. *Ebony* is obtained from the forest. *Oil* is a product for export; the oil-palm is the chief source. *Rubber* is, next to oil, the principal product for export. It is obtained from creepers in the undergrowth. The *elephant* roams the forest. The *hippopotamus* sports in the rivers. Cereals, such as *millet*, the staple food of the eastern half of the continent, cannot be cultivated in so rainy a province.

The **Savannah type of vegetation**—mixed trees and grass—is characteristic of lands with less copious and more intermittent rainfall. Such is the type on the high and dry tablelands and mountain slopes. Climate is more suitable to Caucasian races, and Arab nomads have penetrated the continent from the north-eastern angle, rearing *cattle* and *horses* on the grass-lands and hunting the *big game* so characteristic of these drier and more open lands. The lion,

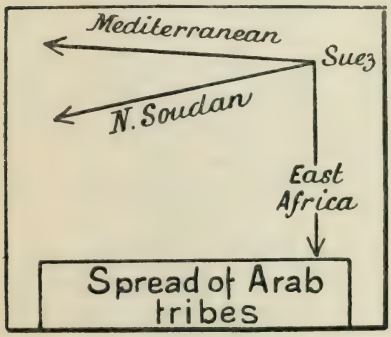


FIG. 341.—SPREAD OF ARAB TRIBES.

the elephant, the zebra and the tall giraffe roam among the tall grasses of the savannahs of Tropical East Africa. *Millet* is cultivated by negro servants. Some of the grasses (*e.g.*, esparto) are suitable for *paper-making*. *Coffee* thrives on the coast-facing slopes. *Cotton* and *rice* are grown on the damp flood plains of the rivers and coast.

Where the rainfall is less, the savannah passes into **steppe-country**—grass-lands without trees. Such regions are the homes of *sheep* and *goats*. If rainfall is not too slight, the *vine* and *maize* thrive. The veld south of the Zambesi, the southern fringe of the Sahara and the dry area east of the Central Lake plateau are such regions.

Where steppe passes with decrease of rainfall into **scrub**, there the *ostrich* and the *camel* occur. The former is famed for its feathers, while the latter affords the only suitable beast of burden for the waterless desert.

Acacia plants, mimosa and the cactus mark the fringe of the sandy waste. *Date-palms* characterise the oases. *Salt* deposits mark the former presence of salt lakes now evaporated to dryness. Dates and salt are therefore the prime exports of Sahara. *Wool* and *goat's-hair*, together with *ostrich-feathers*, are the chief source of wealth to the farmers on the veldt and steppe-lands.

The **Atlas region**, including Morocco, Algeria and Tunis, belongs, physically, climatically and productively, to Europe. Fruits of the *Mediterranean type* grow here and not elsewhere in N. Africa. Rainfall is *cyclonic* in origin.

The drier and lower Tertiary plain supports the dense population of the Nile delta.

The map on page 711 divides Africa up into its physical units. The student will do well to fill in the following table with data referring to the different areas. In no better way can he realise the distinctive features of each unit. By comparing this completed table with that given on p. 32 of "Europe" in this series, he will be impressed with the difference between the two continents.

FIG. 342.—GEOGRAPHICAL UNITS OF AFRICA.

Geographical Units.	Climatic Data.					Agriculture.				Density of Population.
	Summer t°.	Winter t°.	Range of t°.	Rainfall.	Elevation.	Nature of Soil.	Crops.	Cattle.	Sheep.	
The Atlas Region										
The Sahara Desert										
Lower Egypt										
The Niger Basin										
The Upper Nile										
West African Coast Belt										
The Congo Basin										
The Great Lake Plateau										
The Somali Peninsula										
The Eastern Sea Board										
The Zambesi Tableland										
The Veldt										
The Kalahari Desert										
South African Coast Belt										
Madagascar										

CHAPTER III.

EUROPE IN AFRICA.

Exploration, Partition and Commercial Development of Africa.

[Maps to be studied: Geological, Commercial, Political and Population Maps of Africa.]

Early Exploration and Settlement.—We have noticed in Chapter II. that **Arab races** spread from the Asiatic frontier along the portions of the continent similar in climate and character to their own home peninsula. Their wanderings carried them to the *Atlantic margin* along the northern steppe-like fringe of the Sahara to the *Niger interior* around Timbuktu along the southern fringe of the desert, and *due south* along the grass belt lying to the east of the tropical forests. From the eighth to the twelfth century Arab settlements were establishing themselves. The countries still unappropriated by European powers in the North and East are to this day Arab in type.

Only with the *fifteenth century* did *Europeans* begin to take interest in the unexplored continent. Whilst Spain was busy in and around the S. American continent and barred by Papal bull from interfering in the African continent, **Portuguese** sailors were creeping along the western coast. They touched the *Gold*

Coast in 1460, gained the mouth of the *Congo* by 1482, and passed the *Cape* in 1488. Vasco da Gama reached *Mombasa*, then an Arab station, on his way to India in 1497. Thus by the end of the fifteenth century the outline of the continent was familiar to Portuguese navigators. The coast, however, afforded very *few harbours*; it was in many places the margin of boundless desert; where the desert gave place to fertility, swamps and pestilential climate repelled; the Cape of Good Hope was to them the Cape of Storms.

Not until the *seventeenth century* did they venture into the interior. The lower *Congo* on the west and *Abyssinia* on the east were visited.

A year of great moment was 1652, when **Dutch refugees,** driven from Europe by persecution, founded *Cape Town*, and thence afterwards spread during two centuries, "trekking" to get beyond British influence, until they reached the Limpopo.

MODERN EXPLORATION.—The last years of the eighteenth century and the beginning of the nineteenth saw an attempt to explore the Niger Basin by way of the Gold Coast. In 1797 **Mungo Park** lost his life in the river. *Timbuktu* was the goal of explorers. In 1800 an expedition crossed the desert from *Tripoli*; in 1819 the salt *Lake Chad* was discovered; not till 1880 was Timbuktu gained from the Atlantic shore.

Whilst Mungo Park was tracing the Niger, the British gained a lodgment in S. Africa by conquest (1795). By 1812 they had spread along the coast belt. In 1837 the country north of the Orange delta was explored.

But the greatest triumphs of exploration began with **David Livingstone,** the missionary, who entered the continent in 1840 by way of the *Zambesi*; these triumphs are chiefly associated with the *Lake plateau of East Africa* and the solution of its *drainage* to the Nile, the Congo or the Zambesi. In that year Livingstone reached the Zambesi from the south; by 1853 he

had traced the river throughout its length; 1858 saw him on the shores of *Lake Nyassa*, and in 1865 he arrived at *Nyangwe*, the meeting place and general mart of the Arab traders, on the Upper Congo. It remained for **Stanley**, who first went out in 1871 to discover Livingstone, about whom nothing had been heard for some time, to clear up *the Congo problem* by making his way to the mouth of the river from Nyangwe, quite 2,000 miles from the sea.

Whilst Livingstone was pushing northward and inward from the south, **Burton** and **Speke** were penetrating the lake-plateau southward by way of the Nile. *Lake Tanganyika* was discovered in 1858, and, on the return journey, the broad lake of *Victoria Nyanza*. **Baker,** another explorer bent on elucidating the Nile hydrography, found *Lake Albert Nyanza* (nyanza = water).

The *volcanoes* of East Africa have proved of great interest to scientific geographers, and have given rise to expeditions to their regions. **Dr. J. W. Gregory** made the first ascent of Mt. Kenia, on the Equator, 1,400 feet higher than Mt. Blanc. Its snow-cap was believed by the natives to be a cone of silver.

PARTITION OF AFRICA.—Following inevitably upon exploration came the desire among the European powers for new territory.

The **Portuguese** retain strips of coast both on the east and west.

The **Dutch** lost their possessions on the *Gold Coast* to Great Britain in 1871 and came under British rule in South Africa by the conquest of the *Orange Free State* and the *Transvaal*—two distinct Boer Republics—in the second Boer War, which terminated with the Peace of Vereeniging in 1902.

Germany secured a footing on the Gold Coast and the *Kamerun* country. She hastened to secure the seaboard—uninviting though it is—between the Orange River and

Portuguese Angola. On the east, German enterprise gained the *middle portion* of the Lake plateau, hemmed in by the three chief lakes and the sea.

France has, since her occupation of *Algeria* in 1830, exploited the *Sahara* and extended her power to the Gambia River, the Gold Coast and, by way of Lake Chad, to the mouth of the *Congo* (1899). Since 1890 *Madagascar* has been a French protectorate. France also has a strip of country at the important outlet of the Red Sea.

Italy has acquired two distinct possessions in this corner of the continent, separated by French Somaliland.

Belgium, by an arrangement with the European Powers made in 1876, controls the *Congo Free State.*

The **Turks,** Mohammedans like the Arabs, retain suzerainty over Tripoli, but not over Morocco, which remains independent.

Liberia is a free state given to freed slaves who returned to their native land from the cotton and sugar plantations of America on the abolition of slavery.

BRITISH AFRICA.—The map given on page 717 reveals how large a share **Great Britain** has secured in the new continent. The *Gambia River* settlement, *Sierra Leone*, *Ashanti* (the outcome of the Gold Coast settlement), and *Nigeria*, acquired from the original base of Lagos, represent our possessions in the tropical forest belt. The climate is trying to Europeans and the English population is small in proportion to the native.

Two chief *lines of British acquisition* start from extreme ends of the continent, and sooner or later must be linked along the line of lakes which continue from L. Tanganyika to Albert Nyanza.

1806 saw the British in possession of *Cape Colony*; the next advance was along the coast belt to *Natal* in 1838. 1856 gave Natal a separate constitution: self-government was secured in 1893. Five years later *Zululand*, after giving much trouble,

FIG. 343.—THE LION'S SHARE IN THE PARTITION OF AFRICA.

was annexed to Natal (1898). West of the Orange Free State and Transvaal—then Boer Republics—British enterprise was gradually pushing along the veldt toward the Zambesi. *Bechuanaland* was acquired in 1884, and *Matabeleland* in 1888. The British have now pushed their control to the great Lakes of *Tanganyika* and *Nyassa*.

Dutch outnumber British by five to one in South Africa. The Boers are farmers; the discovery of gold and diamonds, mostly within Dutch territory, drew many British over their frontiers. Political conflict ensued.

An earlier war gave favourable terms to the Boers, who retained their republics. The war which came to an end with the *Peace of Vereeniging* in 1902 deprived the Boers of self-government, and opened up the possibility, fraught with *racial difficulties*, of a confederated South Africa from the Cape to the Lakes, which dream has been partly realised (*see p.* 746).

Great Britain commands the Nile from mouth to source. *Egypt proper*, below Wady Halfa, is nominally under *Turkish* suzerainty, but the *importance of the Suez route* is so great that France and Great Britain, the dominant partners in the Canal, have interfered. From 1811 onward the *French* were supreme, but in 1882 military disturbances led *Great Britain* to bombard *Alexandria* and quell the disturbance by a victory at *Tel-el-Kebir*. The French rendered no assistance, and so, since 1882 the British have assumed the protection of Egypt, to the great advantage of that country.

Egyptian Sudan became British at the *fall of Khartum* in 1885 at the hands of Lord Wolseley, who arrived too late to relieve General Gordon. But rebellion revived, and Lord Kitchener followed with the final victory at *Omdurman* in 1898.

British East Africa, whose boundaries were settled by agreement with Germany in 1888, opens up a short way from the Nile sources to the ocean. The islands lying off the German seaboard are under British control. *Zanzibar* is the most important station on the East African coast.

600 miles of German territory separate the Nile-extension of British territory from the South African line of advance. Otherwise, a line of British rule quite 5,000 miles in length would be established ($\frac{7}{36}$ of 25,000 miles = nearly 5,000 miles).

The important *trade route of the Red Sea* is secured for Great Britain by her *dominant share* in the *Suez Canal*, her possession of *Perim Island*, the military station of *Aden* and *British Somaliland* (acquired in 1884).

MINERAL RESOURCES.—**Gold** and **diamonds** are practically the only mineral output of this yet undeveloped continent. It was **gold dust** in the sands washed down upon the *Guinea Coast* from the crystalline rim of the Niger basin that tempted Europeans to risk the dangers of a peculiarly unhealthy coast. The discovery of rich sources of **gold** in the quartzose crystalline ridges in the Dutch-Boer territory of the Transvaal drew thousands of prospectors and miners to the Witwater's Rand and made Johannesburg less Boer in character than any town in South Africa. Gold is known in Abyssinia.

Diamonds are found in the blue-mud derived from the weathering of *ancient lavas* in the neighbourhood of Kimberley.

Copper is mined around the mouth of the Orange River and in the ridge of Primary rocks which divides the Upper Nile from the salt basin of L. Chad.

Salt is one of the staple exports from the deserts and interior salt-basins, the product of evaporation to dryness of the lake-waters. The student may note that *salt deposits and copper shales are often associated* in rocks of New Red Sandstone age (Trias).

Iron ores are plentiful throughout the continent, but as yet little worked. Some iron is exported from Algerian ports, having come from the Atlas. Ironworkers are known in the Nile section of the Sudan.

Coal and iron in their usual association occur on the flanks of the Drakensberge—the culminating range of South

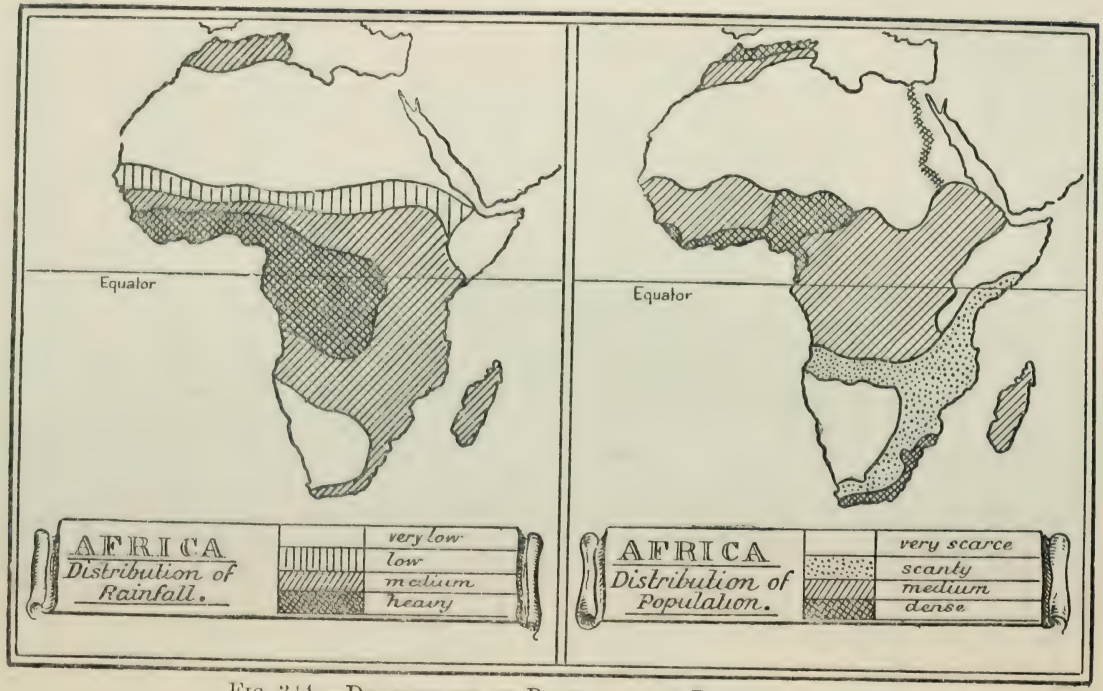


FIG. 314.—DEPENDENCE OF POPULATION ON RAINFALL IN AFRICA

Africa. Several coalfields are scattered over the Zambesi Tableland.

DISTRIBUTION of POPULATION.—A map of African rainfall compared with a map of population brings out the striking fact that in Africa density of population is coincident with intensity of rainfall. The fact, of course, is that fertility is proportionate to rainfall in a continent *homogeneous in rock character* and *uniform in high temperature*. Productiveness determines capacity for supporting population, hence the resemblance in the maps. The comparison of the two maps also shows that Africa in its present state of development is *dependent on its agriculture* rather than on its mineral and manufacturing wealth. These latter have gained importance only in South Africa where British enterprise has opened up the coal and metals of the colony.

CHAPTER IV.

External Commercial Relations and Internal Communication by Rail, River and Caravan.

[Maps to be studied: Commercial Map of Africa; Trade Routes of the World; Orographical Map of Africa.]

PORTS AND TRADE ROUTES.—The great ports of Africa derive less importance from the resources of the continent which lie behind them than they do from their relationship to the great trade routes—past and present—along which they happen to lie. The islands of Africa gain a significance, out of all proportion to their resources, as ports-of-call for steamers destined for richer and more distant lands.

The ports of Europe have the choice of two routes to India, the East Indies, Australia, China and Japan, both of which routes follow the African coast. The **Cape Routes** use the islands along the submerged ridge of the Atlantic. The **Suez Route** follows the Mediterranean, gains the Red Sea by means of the Suez Canal, and opens out in the Indian Ocean for India and the East, or Australia and the Antipodes.

Cape Town, at present sixth among the towns of Africa in the extent of population, as the natural gate of the South African Commonwealth and the only city with resources behind it between Europe and India or Europe and Australia, may be

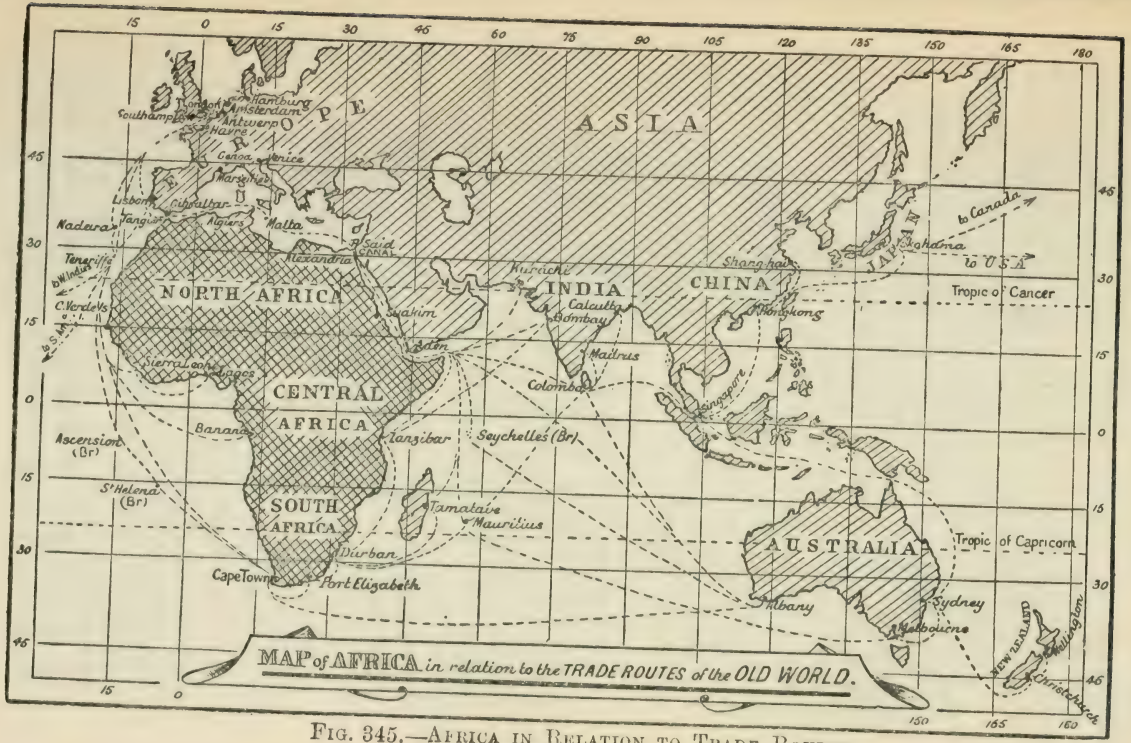


FIG. 345.—AFRICA IN RELATION TO TRADE ROUTES.

expected to advance to second (if not to first) rank among the cities of Africa.

The island ports-of-call on the Cape Routes are mostly British possessions; *e.g.*, Ascension, St. Helena and Mauritius.

At present the great ports of Africa are chiefly found on the **Mediterranean fringe.** They do not owe their importance to the Suez route. Most of them are practically stationary in population. They existed long before the Canal was made. The explanation of their importance is to be found in the past history of this, the most important of the world's inland seas. The *earliest known civilisation* flourished on the shores of Lower Egypt. *Greek* and *Roman* Empires prospered and fell into decay on the European peninsulas and the opposite African fringe. The *Arab-Berber* races from the east followed, establishing states all along the Mediterranean from Egypt to the Atlantic. *Venice* traded with the ports of the African seaboard in the palmy days of the Venetian Republic. *Genoa* traded with the fertile Atlas border. *France* in modern times has conquered and secured the best part of the Mediterranean coastal belt in Algeria and Tunis, and from this base has pushed into the interior, exploiting the Soudan and touching the Guinea Coast.

Algiers and *Tunis* in the Western Mediterranean and under French dominion, *Alexandria* and *Port Said* in the Eastern Mediterranean and under British control, are the chief ports on this route. *Gibraltar* and *Malta*, British stations, belong to the continent of Europe. The Red Sea is walled in by desert. *Suez* stands at the Red Sea end of the canal. *Aden* is the port-of-call at the Indian Ocean outlet of the desert-walled trough. The British port and fort—Malta—stands conveniently midway in the Mediterranean track. *Alexandria* exceeds in population the three ports of Algiers, Tunis and Port Said together. It is the gate of Egypt as *Cairo*, nearly twice the size of Alexandria, is the focus and emporium. *Port Said* gains its importance as the gate of the Suez Canal.

Algiers and *Tunis* export the produce of the Atlas coastal belt to *Marseilles* and other European ports.

The neighbouring state of **Morocco** has its chief outlet in *Tangier*, just outside the "pillars of Hercules," opposite Cadiz. It has similar exports.

The **Portuguese**, as we have seen, first skirted the Atlantic Coast of Africa, and then, after successfully passing the Cape of Storms, followed the East African Coast as far as Zanzibar Island. *Zanzibar* was, and still is, the great focus of East African trade. The Arabs had already developed it when Portuguese navigators touched it. It was from the Arab traders and sailors that the Portuguese learned of India and the Spice Islands, and so first pioneered the Cape Route from Europe to the "Far East." They eventually reached Japan. The different powers have established outlets for their different territories along the coast.

Bathurst, *Freetown*, *C. Coast Castle* and *Accra*, *Lagos* and *Bonny* are the chief gates of **British** trade in West Africa. *Boma* is the port of the Congo Basin (Belgian protectorate). The **Portuguese** have *Loanda* on the west and several stations on the East African coastal plain opposite Madagascar—*Mozambique*, *Beira* and *Lorenzo Marquez* being the chief. **German** stations are as yet of little importance. *Mombasa* on the mainland is the future gate for **British East Africa** but *Zanzibar*, 30 miles from the Germano-African coast, with a population greater than Cape Town, is under British protection.

Cape Town, *Port Elizabeth* and *Durban*, as the termini of the railways which run the length of **British S. Africa**, are the principal ports beyond the southern tropic.

Madagascar has its outlet in *Tamatave* on the more hilly and more healthy slope turned away from the African continent. *Antananarivo*, the capital of the island, stands well elevated in the interior.

RIVERS of AFRICA as LINES of TRANSPORT.—We have seen that the *Nile* and the *Niger*, the *Congo* and the *Zambesi*

offered lines of access for explorers to the heart of the tropical continent. Now that European countries are developing the tropics, these rivers form the natural means of communication, where tropical forests make railway construction difficult and expensive, and where the resources do not as yet warrant such expenditure.

But these rivers are not valuable in proportion to their length and volume. *Cataracts* are numerous, as in all countries of plateau-type; moreover, *deltas* and *flood-shallows* are met with, detracting from the value of these mighty rivers.

The ORANGE RIVER is almost negligible as a means of transit.

The NIGER is a fine, navigable river in its lower and upper courses, but the middle portion below *Timbuktu* is unsuitable.

The CONGO affords 2,000 miles of navigable river through the tropical forest from *Leopoldville*, above the falls in the coastal-rim, to *Nyangwe*, the emporium of the Upper Congo, the focus of exploration in Central Africa and an Arab mart.

The ZAMBESI flows through country only sparsely peopled and as yet undeveloped.

The NILE links the great lakes with the Mediterranean, but the great cities of the plain owe their greatness to the *fertile flood-plain* of the river rather than to the possibilities of communication with the tropics which the river affords. No less than six rapid-like cataracts occur between the uplands at *Khartum* and the plain at *Assouan* (or *Aswân*). These towns and *Berber* (between them) are destined to become foci of Upper Nile development. Berber will probably be joined up by rail with *Suakim* on the Red Sea.

CARAVAN TRADE.—The desert belt stretching across North Africa and Central Asia is *the* region of caravan-transit. The *camel* is the beast of burden in the desert regions where oases are few; the *horse* serves in the steppe-lands which fringe the desert belt and mark the transition from desert to fertility.

The Arab races, nomadic in habit and of necessity, are the chief carriers by caravan. They knew the Sahara long before Europeans penetrated Africa.

Timbuktu in the desert and *Nyangwe* on the Upper Congo forest margin had been reached by them and used as trading centres for many generations before Mungo Park or Livingstone first ventured into the dark continent.

Caravan routes are less important than formerly, except in the *Sahara.* French control in the Soudan has developed what resources the desert possesses in its *oases* (date-palms) and its *salt-basins* (salt for export), and so kept the caravan trade alive and flourishing. Routes are very well defined, starting from definite towns as bases, linking up oases and converging on the fertile margin beyond the desert belt. *Timbuktu*, a town of 21,000 inhabitants, and *Kano*, a town now included within the British area of Nigeria, with a population of 60,000, are caravan-centres of very ancient standing. The towns of the Atlas converge on *Tuat* and then link up the salt-basin of *Taudeni* with Timbuktu and the Niger. *Tripoli* is a base from which to reach the oasis of *Ghat* and the walled city-mart of Kano.

RAILWAY DEVELOPMENT.—*South Africa*, the *Nile Basin* and the *French Atlas*, regions affected most by European influence and ideas, have naturally developed more railways than Tropical and Saharan Africa. *Rivers* and *caravans* must remain for a long time the means of transit in the *forest* and the *desert* respectively. The *coastal belts* and the *plateaux* offer free course for *railways*, and, moreover, the fertility of the one and the mineral resources of the other encourage development and railway construction.

Great Britain has developed the railways of *Egypt* and *South Africa.* **France** has extended the coast railways of the Atlas from *Oran* to *Tunis*, but Morocco refuses to entertain railway modes of transit.

(*a*) **South African Railways.**—*Cape Town*, *Port Elizabeth*, *East London* and *Durban* are linked up with *Bloem-*

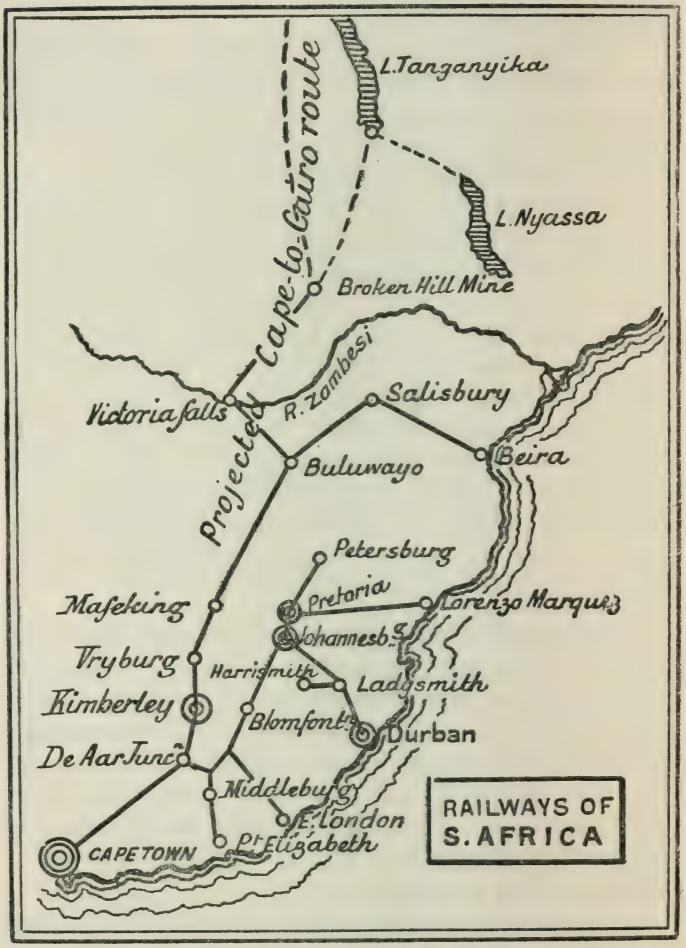


FIG. 346.—RAILWAYS OF SOUTH AFRICA.

fontein, *Kimberley*, *Johannesburg* and *Pretoria*. A main line is carried forward into tropical South Africa, where *Bulu-*

wayo, the Matabele capital, is becoming an important railway centre. Mr. Cecil Rhodes' project of a **Cape-to-Cairo line** is anticipated by the main line along the veldt having been carried forward from Buluwayo over the Zambesi, at the famous falls, to Broken Hill Mine. It is projected as far as the southern end of Lake Tanganyika, and steam navigation already exists along the 400 miles of the lake. The northern end of the lake is only 250 miles from Victoria Nyanza, the principal source of the Nile. An important line links *Buluwayo* by way of *Salisbury* in Mashonaland to *Beira*, which promises to become the chief port of Portuguese Central Africa. But a branch line from *Pretoria* to Delagoa Bay makes *Lorenzo Marquez* a formidable rival.

Johannesburg, the largest town in South Africa, and the capital of the gold industry, is naturally the chief railway focus of the interior.

(*b*). **The Nile Railways.**—In Egypt the railway follows the river very closely, since the fertile strip above the delta is only about eight miles wide on either bank of the river, with an average width of 15 miles from *Cairo* to *Assouan*. This line of flood-plain is one of the most densely peopled lines in Africa. The railway follows the west (or left) bank from Cairo until midway between *Asyut* (or *Siut*) and *Assouan* (or *Aswân*) it changes to the east or right bank.

From *Assouan* to *Wady Halfa* the line remains to be made. From Wady Halfa the cataracts are avoided (though in flood season they can be navigated) by a line to *Khartum*, the capital of the Nilotic Soudan. Short and easy communication with the Red Sea is afforded by means of a line from *Berber* to *Suakim*. Fig. 347 shows the relation of the Nile to the Cape-to-Cairo overland route, and should be studied in connection with Fig. 346.

Lake Tanganyika occurs on both maps and forms the link between the Nile and the Cape systems.

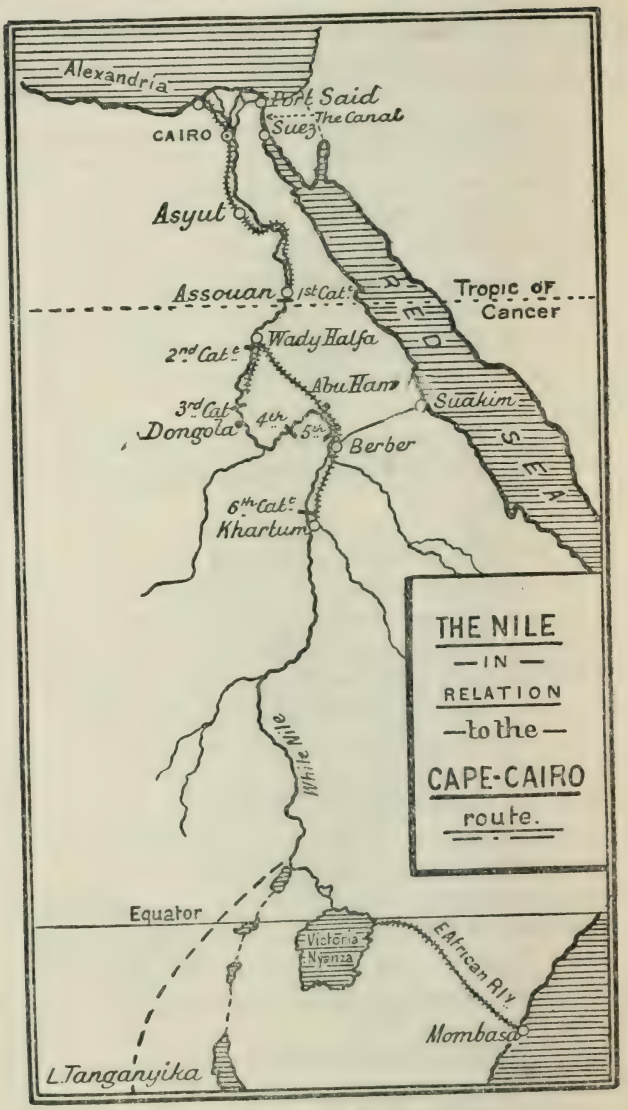


FIG. 347.—THE NILE TRAFFIC-LINES.

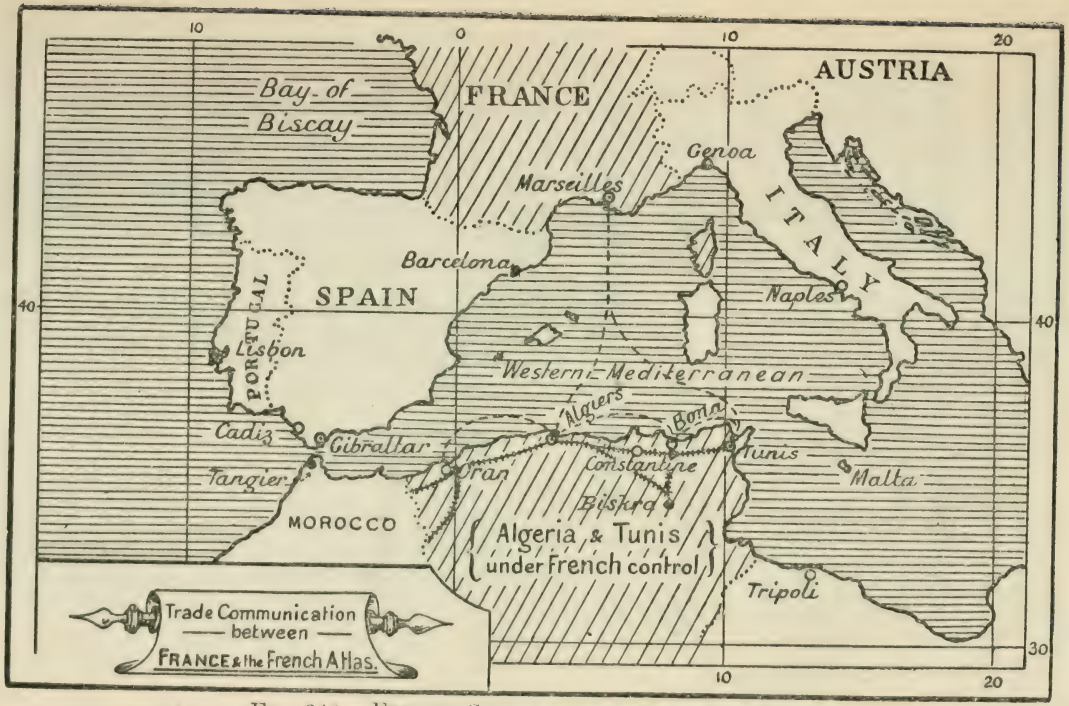


FIG. 343.—FRENCH COMMUNICATIONS WITH THE ATLAS.

The *East African line* will join the *Nile-Cape trunk* with the Indian Ocean and the distributing centre of *Zanzibar*, 50 miles from the terminus at *Mombasa*.

(*c*) **Atlas Railways.**—The Algerian railways link up the busy ports along the Mediterranean from the Moroccan frontier to Tunis. The coastal plain is a line of *dense population*, trading with Mediterranean ports and especially with France, through *Marseilles*. Other short lines run from coast-ports toward the interior.

Table of Populations (in round numbers, for reference only).—

[Towns in the British Isles are given in italics—for comparison.]

Manchester	714,000	
Cairo	655,000	(Mediterranean)
Bristol	357,000	
Alexandria	332,000	
Tunis	300,000	,,
Johannesburg	170,000	(S. Africa)
Fez	140,000	(Atlas border)
Morocco	140,000	,,
Huddersfield	108,000	
Oran	106,500	(Atlas border)
Antananarivo	95,000	(Madagascar)
Cape Town	92,000	(S. Africa)
Durban	70,000	,,
Tangier	35,000	(Atlas border)
Freetown	34,090	(W. Africa)
Kimberley	34,000	(S. Africa)
Port Elizabeth	33,000	,,

CHAPTER IX.

From the Cape to the Zambesi—A New South Africa.

APPROXIMATE CO-ORDINATES OF:—

CAPE TOWN: $18\frac{1}{2}°$E., 34°S. JOHANNESBURG: 28°E., 26°S. DURBAN: 31°E., 30°S.

Colonisation.—Just a hundred years have elapsed since Cape Town became a British station (1806). For 150 years it had served as a convenient port-of-call for vessels trading between Europe and the developing East. During that period, a "handful" of *Dutch* and *Huguenot* refugees had landed and settled on the soil. Their descendants are the Boer peoples of South Africa. The appearance of British settlers led to "trekking" of Boer families and communities—(*a*) *along the coast-lands* towards Natal, and (*b*) *over the terraces* of the Karoo to the wide open tableland of the veldt. The *Boers* were essentially a pastoral people, and they employed the negroes who were native to the soil as farm-slaves.

From 1806 onward the number of *British settlers* increased, and especially after 1814, when the *Treaty of Paris* recognised the Cape as a British possession. A strong feeling against slavery was growing up among British subjects everywhere and culminated in the *abolition of the trade* within British dominions in 1833. Boer farmers who, since 1814, had been subject to British rule, disliked the new *régime*, and "trekked," as mentioned above, in their heavy waggons drawn by teams of oxen.

Eventually driven from the coastlands by the advance of the British and the declaration of *Natal* as a British colony (1843), they set up Boer Republics on the veldt, using the principal rivers draining from the Drakensberge (Dragon Mountains) as political frontiers.

The Orange Free State, founded in 1854, included the territory between the Orange and the Vaal, whilst the *Transvaal* or *South African Republic* (1852) extended along the veldt from the Vaal to the Limpopo. *Basutoland*, between the Orange and the Caledon tributary, remained British. The Transvaal transgressed the Drakensberge wall as far east as the foot-range overlooking the unhealthy coastal plain of Portuguese East Africa.

The Transvaal has all along offered more resistance to the British than the Orange Free State ever did; 1877 saw it annexed to Great Britain; rebellion secured its independence in 1881.

It is in the Transvaal that *gold* has been discovered in such considerable quantities. Prospectors from many lands, but especially from Great Britain, entered the Republic. Disputes about political rights led to intense inimical feeling between Boer and Briton. The problem was increased by the uncertainty of the part that the Cape Dutch would play in the event of war. The war of 1899-1902 put an end to Boer rule in South Africa.

Meantime the British had pushed along the western edge of the veldt between the Boer Republics and the (now German) Kalahari desert.

The *Kimberley diamond fields* were opened out in 1871; *Bechuanaland* became British in 1884; the *Chartered Company of British South Africa* pushed forward north of the Limpopo, and by negotiation with native chiefs established British influence over the Zambesi tableland as far as Lake Tanganyika (2,000 miles from Cape Town) and the Congo "divide."

The *Zambesi tableland* is conveniently divided by the curves of the river into three administrative districts, whose names indicate their political origin in the enterprise of the late Cecil J. Rhodes.

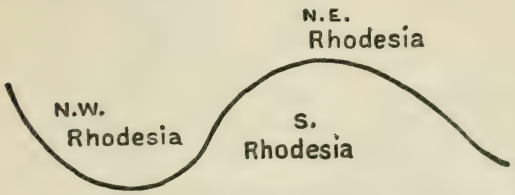


FIG. 349.—THE RHODESIAN DISTRICTS.

The *British Central African Protectorate* occupies the shores of *Lake Nyassa* and the valley of the *Shiré River*, but does not extend so far as to give Britain control over the Zambesi outlets.

It will be clearly seen from Fig. 350 that, north of the Orange-Vaal river-frontiers, British territory is confined to the tableland and practically occupies the whole of it for a distance of 1,500 miles. It is, however, the most valuable portion of this practically tropical zone of South Africa.

To the west lie the *Kalahari rainless sand-waste* and the *Ngami salt-basin*, reproducing in miniature the physical features of the *Sahara* and *Lake Chad*. Along the east runs the low, damp, coastal belt of *Portuguese East Africa*, more like the Guinea Coast of West Africa in matters of climate and production than any other portion of the African seaboard on the Indian Ocean. The one region offers little resource and much difficulty owing to *absence of water*, the other deters European colonists owing to the *unhealthiness* of its climate.

Separated from this low coastal belt by the wide *Mozambique Channel* rises the mountain-walled island of *Madagascar*, a possession of the *French* since 1885. The island is a geographical unit in itself, standing as it does with

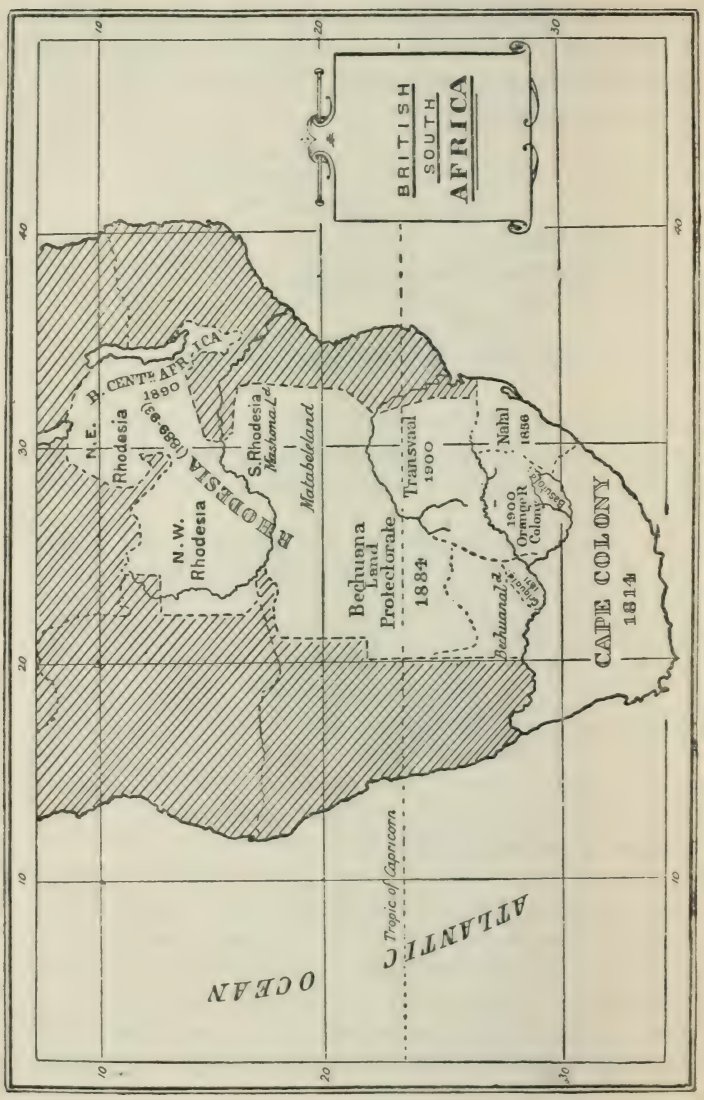


FIG. 350.—BRITISH SOUTH AFRICA.

one steep slope of its mountain-wall almost normal to the rain-winds of the Indian Ocean.

Occupying the same latitudes as Portuguese East Africa and the Rhodesian tableland, it acts as a partial *rain-barrier* to these mainland territories.

The Tropic of Cancer practically *bisects* British South Africa; newer undeveloped lands lie within the tropics; the older colonies and the recently-acquired Boer territories are beyond the tropic in the South Temperate Zone. The *latitude-belt* of British South Africa is almost identical with that of the *Australian continent.*

Physical Characteristics.—The *South African peninsula* beyond the Congo sources and Lake Tanganyika is a *tableland* of remarkably uniform character and wide extent. The only noticeable *coastal plain* is a strip from the Cape to Durban, widening out in Portuguese East Africa from Delagoa Bay beyond the delta of the Zambesi to Mozambique at the narrowest point of the channel of the same name.

The general *tilt* of the northern and larger section is eastward, giving the river systems of the *Zambesi* and the *Limpopo.* The slope of the southern section is westward and drained by the *Orange* and its feeders. The Zambesi and the Limpopo are within the Tropics and, fed by seasonal rains, are alternately flooded and comparatively dry. They have carved *deep valleys in the plateau* and spread out broad *deltas* at their mouths.

The *Orange* rises on the dry side of the Drakensberge rain-barrier and, flowing towards an almost rainless lowland, shrinks in volume as it proceeds. Its mouth is so choked with silt that an entrance for navigation is impracticable.

Encircled by the Zambesi, Limpopo and Orange watersheds are the *Kalahari desert* and its concomitant, the *Ngami salt-basin.*

The build of the plateau is comparatively simple. *Folded mountain ranges* are absent; *Tertiary and Secondary rocks*

are practically absent, with the prominent exception of the *Trias Sandstone*, so characteristic of African basins, and the most conspicuous surface formation in South Africa.

The foundation of the plateau is a *crust-block* of crystalline rocks—the "*fundamental complex*" of recent writers. In many parts of the north (Zambesi region) and west (Orange lowlands) it is uncovered by subsequent strata.

But in the south and east, from the Cape to the Limpopo, it is hidden by successive overlying tabular sediments. The **Older Primary rocks** are, of course, sandwiched in between the Trias plateau rocks and this crystalline foundation. They emerge, however, in a broad band *from Port Elizabeth to Cape Town* along the coast; also from the Orange to the Limpopo along the western edge of the veldt, expanding to

FIG. 351.—GENERALISED SECTION ACROSS SOUTH AFRICA.

occupy well-nigh the whole of the Transvaal. Moreover, they *crop out* in the colony of Natal along the seaboard.

The *Karoo terraces* and the *veldt* of Cape Colony and the Orange River Colony are built up of *tabular sandstones of Trias age* (Upper New Red Sandstone), and the broad ledges, in which the lower portions project beyond the upper, form the terraces of the Karoo. Intercalated with the sandstones of the Karoo are many bands of *intrusive igneous rocks*, which in the Kimberley district yield *diamonds* in such remarkable quantity. Diamonds are looked for in these rocks further north.

Only in the Kalahari sand-waste and the Ngami salt basin (if we exclude the small basin of Algoa Bay) do rocks younger than the Trias age occur, and these are the usual *flood-deposits* and *wind-worn sands* of such arid areas, the former in the salt basin, the latter in the rainless zone.

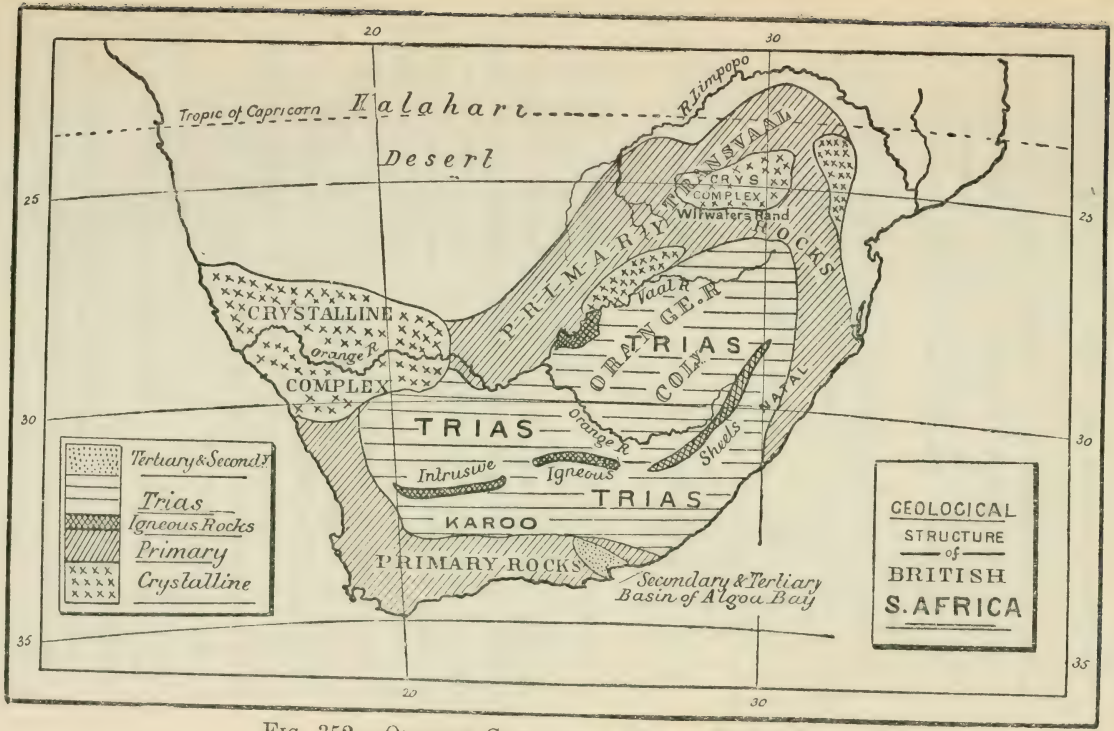


FIG. 352.—OUTLINE GEOLOGICAL MAP OF SOUTH AFRICA.

The Trias deposits and their accompanying intrusive basalts, not so prominent in the Transvaal, reappear in the Zambesi region, and give rise by the unequal erosion of their surfaces to *ravines* and *waterfalls*. The *basalts* are much more resistant than the sandstones. It is, however, in the Older Primary rocks that the mineral wealth of South Africa chiefly occurs.

The gold of the Transvaal and Rhodesia occurs in quartzose reefs (the Main and Black reefs) among Older Primary rocks. The *coal* of Natal, and the recently-discovered coal on the Rhodesian tableland is associated with the red rocks which form the surface of the veldt.

Copper occurs in the ancient rocks around the mouth of the Orange, especially at Ookiep, and finds an outlet in Port Nolloth.

Climatic Features.—We noticed in Chapter II., that, on the whole, the *rainfall* of South Africa was derived from the *Indian* Ocean rather than from the Atlantic. If we take *Walfish Bay*, a British station on the German South-West African seaboard, as a focus and make concentric circles of increasing size, then the zones included on the map of Africa south of the Zambesi very closely correspond to increase of rainfall as we proceed along any radius from that focus. The first zone is the *Kalahari desert zone*; the second is the *Veldt*, comparatively dry, but fruitful after seasonal rains; the next zone includes the *culminating ridge*, curving round from *Table Mountain* through the *High Veldt*, the *Snow Mountains*, the *Black Mountains*, to the lofty *Drakensberge* (or Dragon Mountains), the highest altitudes in South Africa; the last zone on the mainland is the *coastal belt*, open to oceanic influences from south and east.

Belonging to this same belt should be included the west slope of Madagascar. The final belt is that of the ***steep east-facing slope*** of that island.

Passing from Walfish Bay to the eastern seaboard, the change in type of climate is from extreme to equable, from continental to insular. The elevation of the *Veldt*, however, somewhat modifies the transition in the direction of making it the *most continental* in character. These facts may be illustrated by reference to the isotherms for January and July.

Walfish Bay.	Bloemfontein.	Durban.
January, 75° F.	January, 82° F.	January, 75° F.
July, 60° F.	July, 60° F.	July, 64° F.
Range 15° F.	Range 22° F.	Range 11° F.

The maximum range is where neither ocean current nor rain-wind has much effect; the minimum range is where ocean currents and rain-winds influence the climate.

Effects on Agriculture.—The general *trend of the zones* defined is N.—S.; traversing them we travel W.—E.; the change in vegetation and fauna is therefore *due to rainfall rather than to latitude.* In the Kalahari zone, poor grass, the cactus, the baobab, the euphorbia and the date, are characteristic; big game, flamingoes, monkeys, alligators and the rhinoceros occur.

On the Veldt, *grass* is the natural covering; trees are scarce; wild flowers abound; mimosa bushes are plentiful; maize and durra can be successfully grown. The Zambesi plateau promises well as a wheat-growing country. *Ostriches* occur and can be reared with much success; *sheep*, *goats* and *horses* thrive. *Cattle-rearing* is profitable in latitudes free from the *tse-tse fly.*

The hill-zone is *forested*, though in many of the wildest parts trees are scarce. The Karoo terraces are the special homes of the ostrich-farming industry. The valleys of the coast-streams and the seaboard are the tilled and cultivated regions.

Wine in the southern colonies; *cotton*, *tobacco* and *rice* on the Indian Ocean-border; *oil* and *rubber* from the valleys of the Zambesi plateau and the Portuguese seaboard represent the products of the coastal zone, varying through 20° of latitude.

Population Centres: Industrial and Trade Development; Railway and Shipping Facilities.—*Wine*, *wool* and *feathers* are the principal products of the Cape Colony; the south-east promontory jutting out in the Cape of Good Hope and the Cape Agulhas is the fertile *wine-producing* area, with centres at *Stellenbosch* and *Paarl*; the three terraces of the Karoo export *wool*, *mohair* and ostrich *feathers*, with market centres at *Graaf Reinet* and *Grahamstown*.

Natal, whose capital is 5° nearer the tropic line, has a warmer and damper climate, and is able to grow *bananas*, *pineapples*, *arrowroot*, *maize*, *tea and sugar*. The flanks of the Drakensberge sloping toward Durban carry a *coalfield*, near the sources of the Tugela. *Newcastle* is a fitting name for the coal centre. *Durban* is the emporium of the colony. *Pietermaritzburg*—a name compounded of those of two Dutch pioneers—remains the seat of government.

The Orange River Basin exports *copper* from its lowlands; *diamonds*, *wool* and *feathers* from Griqualand West and the recently-acquired colony on the veldt. The Basuto farmers grow excellent *corn* and *mealies*.

Kimberley is the focus of the *diamond* industry; *Bloemfontein*, a magnified village, is the capital of the Orange River Colony; *Port Nolloth* ships the copper ores of Ookiep.

The Transvaal is given over to *pasture-farming* by the Dutch and *gold-prospecting* by the "Uitlander." The *gold-mining* industry is the most important factor in the industrial development of South Africa. *Johannesburg* has grown to the largest town in South Africa from the discovery of rich reefs in the *Witwater's Rand* (white water's ridge). *Barberton*, further east on the culmination, is another mining centre.

Pietersburg is a more recently-developed centre in the plateau country dividing the Limpopo and its affluent, the Oliphants river. *Pretoria*, the capital of the state, stands north of the Witwater's Rand.

The former Boer territories of the Orange River and the Transvaal have no seaboard; recourse was therefore necessary to British or Portuguese outlets.

The gates of South African trade are *Cape Town* and *Durban*, with *Port Elizabeth* and *East London* as thriving auxiliaries. Portuguese East Africa offers an outlet for Transvaal gold at *Lorenzo Marques*, on Delagoa Bay, in the latitude of Pretoria. The two main lines of railway communication strike along the veldt from the bases of Cape Town and Port Elizabeth. That from Cape Town has been carried to the Zambesi, a distance of 1,500 miles, and is destined, as a part of the "Cape-to-Cairo project," to become the trunk line of a confederated South Africa. It climbs, past *Paarl* and *Worcester* in the wine country, upon the Great Karoo; from *Beaufort West* to *De Aar Junction* it crosses the dreary veldt. The Orange River is spanned at *Hopetown*, and the line now follows the former Brito-Boer frontier past *Kimberley*, *Vryburg* and *Mafeking* to *Buluwayo*, the capital of Rhodesian Africa, formerly the home of the chief of the warlike Matabele. From Buluwayo, railways diverge to the *Victoria Falls* on the N.W., and to *Salisbury* on the Mashona tableland toward the N.E., from which centre a line of export runs to the Portuguese port of *Beira*. The Victoria Falls line is destined to be carried forward either by way of the *Lualaba* oil and rubber district or the lake navigation-line of *Tanganyika* to meet the Nile line of communication.

The different mining and railway centres are indicated on Fig. 353.

A main line, running like a midrib through the *Boer-peopled colonies*, is linked up by diverging lines with the outlets of *Port Elizabeth* and *East London*. The Port Elizabeth line

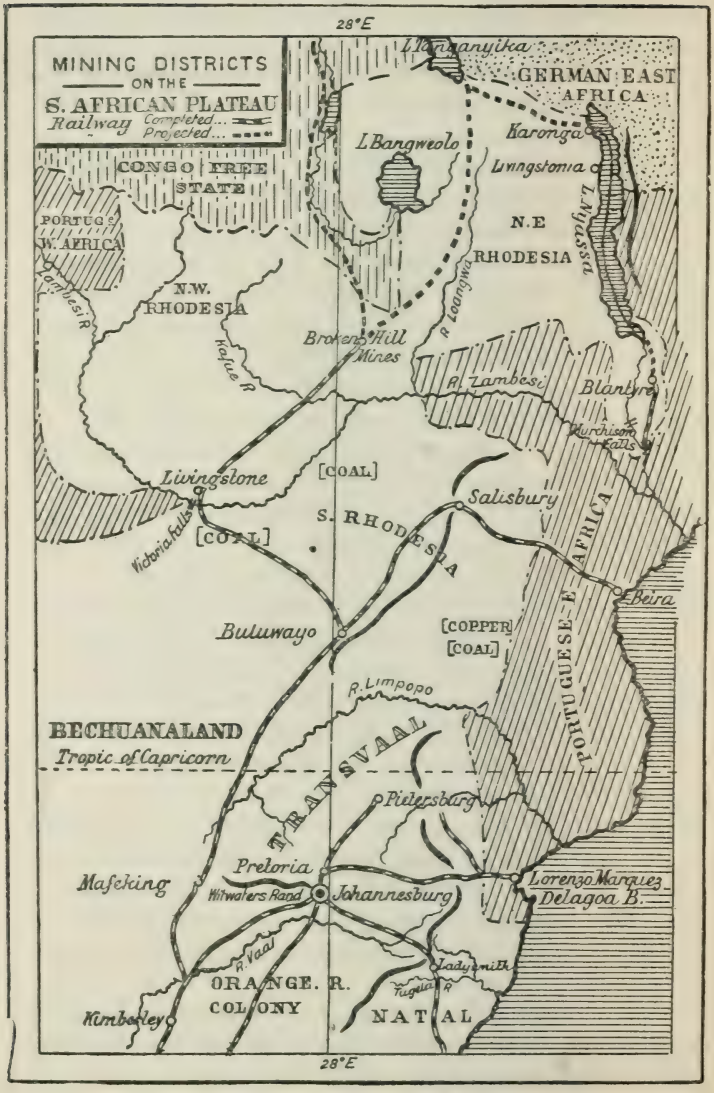


FIG. 353.—THE SOUTH AFRICAN PLATEAU.

ascends the Karoo, passes *Graaf Reinet* and calls at *Colesberg* on the veldt. The East London line calls at *Aliwal North* before linking up with the other branch from Port Elizabeth just across the Orange and within the Orange River Colony. The mid-veldt line joins *Bloemfontein* with *Pretoria*, former Boer capitals, and *Johannesburg* with *Pietersburg*, gold-mining centres. From Johannesburg and Pretoria transverse lines use "kloofs" in the Drakensberge to reach *Durban* (Br.) and *Lorenzo Marquez* (Pt.) respectively. The line from Johannesburg to Durban promises to develop into one of the dominant lines of South Africa. It links the *gold centres* with the *coalfield* of Upper Natal around Newcastle, and brings the exportable material to *Durban*, the thriving and healthy commercial capital of Natal. Now that the Transvaal is British, this railway and its port will probably gain at the expense of the unhealthy Portuguese outlet of Lorenzo Marquez. (*See* Fig. 346.)

The student of South African history will note the bearing of the railway lines on the veldt and the Johannesburg-Durban route upon the movements of troops from Cape Town under Lord Roberts, and from Durban under General Sir Redvers Buller toward the Transvaal capital, Pretoria. *Kimberley* and *Mafeking* on the trunk line; *Bloemfontein* and *Pretoria* on the mid-veldt railway; *Ladysmith* and *Spion Kop* on the Natal route, recall stirring incidents in the prolonged struggle which yielded the Boer territories to British rule.

The problem before South Africa lies not in her climate or her resources, but in the wise government of so heterogeneous a population. The lowly savage *Hottentots* and *Bushmen* are well-nigh extinct and confined to the desert zone. The veldt is peopled by the *Boer* or *Afrikander* race. Cape Colony has *Dutch* outnumbering British in considerable proportion. Natal has a large percentage of *Zulus* (negroes). The *Kaffir* is perhaps the greatest problem to the white ruler—lazy, and incapable of manhood suffrage, he claims the firm and

patient rule of his British superiors. The *Bantu negroes* of the tropical table lands of Rhodesia have shown themselves friendly and amenable to good government.

NOTE.—The *South Africa Act* of 1909 places South Africa in a line with the Australian Commonwealth (1901), the Dominion of New Zealand (1907), and the older Canadian Dominion (1867). Under it the four self-governing colonies—Cape Colony, Natal, the Transvaal and the Orange River Colony—become "provinces" in the new SOUTH AFRICAN COMMONWEALTH, with a Union Parliament sitting in Cape Town. The area of the Commonwealth is just under half a million square miles; the white folk number a million and more; its black subjects nearly four times as many.

GEOGRAPHY OF ASIA.

CHAPTER I.

World Position and Dimensions. General Build of the Continent.

[Maps to be studied: Terrestrial Globe, Mercator's Map of the World, Orographical Map of Asia.]

The great land-mass of the Old World—the largest area of continuous land on the surface of the globe—is, for convenience' sake, divided into *three* continents. Physically it forms only *two* continents, *Eurasia* and *Africa*. Eurasia covers twice the area of Africa.

The deep depression of the *Mediterranean* and the sea-filled rift of the *Red Sea* separate Africa from the northern continent.

The area of *Asia* approaches eighteen million square miles; that of *Europe* is somewhat under four million square miles; whilst the area of *Africa* is just over eleven million square miles. Asia is thus one and a half times the area of Africa, and four and a half times the area of Europe.

As its name suggests, Eurasia is made up of Europe and Asia. The figures given show that Europe occupies less than one-fifth of Eurasia.

Europe is not cut off from Asia in the same way that Africa is. The axis of the *Ural Mountains* serves as a convenient frontier, but both flanks of the range belong to the same political Power (Russia).

In latitude, Asia extends 10° farther north than the *North Cape of Norway*, and 20° farther south than *Gibraltar*. Its extreme west longitude, that of *Smyrna* (26° E.), is nearly

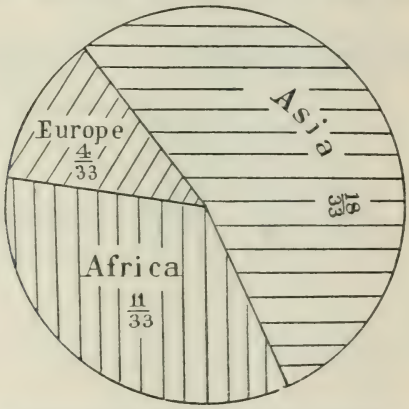


FIG. 354.—COMPARATIVE AREAS OF THE THREE CONTIGUOUS CONTINENTS.

half-way round the globe from the Asiatic latitude farthest east (long. 170° W.—passing through *Bering Sea*).

The mainland of Asia projects farther north than that of *Canada;* but no off-lying archipelago, like that which stretches towards the Pole from the north coast of North America, occurs on the northern border of the Asiatic continent.

From the most northerly cape on the *Taimyr peninsula* to *C. Romania*, due south (on the same line of longitude), the most southerly point on the Asiatic mainland, is a distance of 77 degrees of latitude. Each degree of latitude* is

* A study of the globe will show that the same is not true of longitude, except at the Equator.

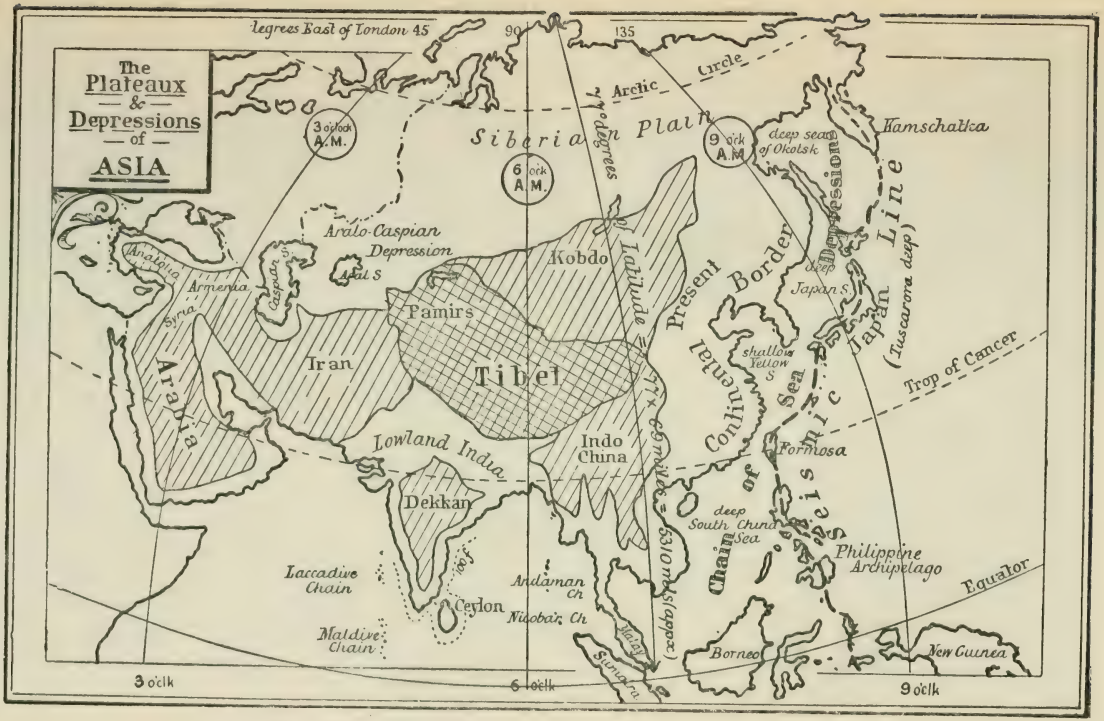


FIG. 355.—THE PLATEAUX AND DEPRESSIONS OF ASIA.

equivalent, on the earth's surface, to about sixty-nine miles. Therefore, the greatest N.-S. line which can be drawn on the continent is 77×69 miles (approx.), *i.e.*, 5300 miles in round numbers. The width of the continent in its middle latitude is about the same.

Asia is more compact than any of the other continents north of the Equator. It has *few penetrating arms of the sea*, and none to compare with the Baltic or the Mediterranean. Asia presents many contrasts to both America and Europe. The most striking feature of Asia is that of the *interior tablelands*, several of which are continental in dimensions. **Europe** has nothing to compare with them, unless it be the *Meseta* of Spain. **North America** has only the Cordilleran plateaux of the Rocky Mountains. In this respect Asia more resembles **Africa**, but the plateaux of Asia are far higher on the average than those of Central and South Africa.

Interior Plateaux.—The core of the continent is in the *Pamirs*. Their general level and that of the wide-spreading *Plateau of Tibet* are everywhere higher than the European Alps or the highest peaks of Africa and Australia, and yet from these plateaux there rise ranges which, in many cases, tower above the plateau itself to a height of 8,000 to 10,000 feet.

The lower tablelands extend from the foot of the Pamirs both to the west and the north.

Those on the north sink to the *Siberian Plain;* those on the north-east to the *China Seas;* the western plateaux of *Persia* and *Arabia* drop steeply to the *Caspian Sea*, the *Persian Gulf*, or the *Red Sea* trough.

Inland Basins.—These plateaux are remarkable for the number of inland *salt-basins* they support. Rainfall is slight; summer heat is excessive; each basin is an *inland-drainage* area. Such conditions always favour salt-basins. The saltness of the water varies, increasing with continued evaporation from the lake surface, so long as evaporation exceeds inflow.

FIG. 356.—GEOGRAPHICAL UNITS OF ASIA.

River Systems.—It is from the outer rims of these plateaux that the great rivers of the continent drain. The *Obi*, the *Yenesei* and the *Lena* drain across the Siberian plain to the ice-bound Arctic coast. The *Amur*, the *Hoang-ho* and the *Yang-tse-kiang* drop off the eastern edge of the plateau to empty their waters in the seas of the Pacific seaboard.

The *Mekong*, the *Salwen* and the *Irawadi* follow the parallel troughs of the Indo-Chinese peninsula, to mingle their waters with those of the Indian Ocean.

The *Indus* and the *Bramaputra* escape from the upland plateaux of Tibet by gaps in the Himalayan wall and water the plains of India before reaching the Indian Ocean. The *Ganges* gathers up the streams on the southern flanks of that lofty mountain wall, and fertilises the plain before adding its waters to those of the Bramaputra.

Ranges and Crust Blocks.—The *parallel ranges* of the Tibetan plateau and those of Asia Minor have an *east-and-west trend*, like the mountain axes of Southern Europe. The ranges on the *Pacific border*, on the other hand, have a trend *parallel to the coast-line*, like the ranges of Norway and of British Columbia. The plateaux of the interior are largely built up of folded rocks. Contrasted with these are the plateaux of Arabia and Southern India (the Dekkan), which are true *block-countries*. The Arabian crust-block is separated from the continental mass by the depression of *Mesopotamia* and the Persian Gulf; the *Dekkan* is cut off from the plateaux of Asia by the low-lying *Plains of India*.

Lowlands.—Apart from these depressions, the lowest parts of the continent lie along the Arctic shorelands and the Russian border of the interior plateaux. The inland-drainage basin of the Aral-Caspian depression is the lowest part of the whole continent; the surface of the Aral Sea is 157 feet above sea-level; that of the still larger Caspian Sea is 85 feet below the surface of the neighbouring *Black Sea*.

Archipelagos.—Asia is remarkable for the number of its off-lying archipelagos. We have already noted that none occur in Arctic waters (if we except the small Liakhov group). The Asiatic archipelagos are more favourably placed than those of Canada, but not more favoured than the West Indies of Central America or the British Archipelago of Europe. They form *a remarkable chain* from the peninsula of *Kamschatka* to the tropic seas north of Australia. The principal members of the chain are—

(*a*) The *Japanese Archipelago*, enclosing the Sea of Japan,
(*b*) The *Philippine group*, which forms the outer wall of the China Sea, and
(*c*) The *East Indian Archipelago*, scattered over the broad platform which links Asia with the island-continent of Australia. Throughout the length of the chain evidences of volcanic and seismic action are plentiful.

The seas lying within the chain are all deep, except the *Yellow Sea*, which is merely a submerged part of the Great Plain of Northern China. These deep seas appear to lie upon *sunken crust-blocks* with mountain-walls for their rims.

In the *Malay Archipelago*, the *Gulf of Siam* and its extension southward to the *Java Sea* are shallow waters covering the submarine continental shelf, from whose broad platform rise the chains of *Malay*, *Java* and *Sumatra*, and the plateau of *Borneo*.

The deep depressions of the *Celebes Sea* and the *Sulu Sea* divide the Philippines from the other members of the tropical archipelago, just as the deep *Banda Sea* divides between the Australian and the Asiatic members of the Archipelago.

Immediately outside the **seismic line** the Pacific Ocean sinks suddenly to oceanic depths. One of the deepest abysses of the ocean occurs just outside the Japanese island-chain (the *Tuscarora deep*, 8,310 metres or 4,550 fathoms).

The seas which wash the shores of India are shallower than the open Indian Ocean. *Ceylon* is an outlier of Southern India, connected with the mainland by a submarine ridge, on which rise the reefs of Adam's Bridge.

The *Laccadive* and *Maldive* island-chains on the west and the *Andaman* and *Nicobar* chains on the east of peninsular India are partially-submerged mountain ranges projecting far out into deep waters.

Comparisons.—Asia rivals America as the continent of big features and wide contrasts. The cold of the *Siberian Plain* is more extreme than that of the *Canadian North-West*. The inland-drainage area of the *Aralo-Caspian* depression is greater than that of *Australia*. The deserts of *Arabia* are less penetrable than those of the *Sahara*. The ranges of the *Pamir* plateau are more difficult to traverse than the *Rockies* or the *Andes*. The mineral resources of *China* will probably prove richer than those of Great Britain or the Basin of the Ohio in the United States. The peninsulas of south-eastern Asia have a distinct climate of their own—that of the *monsoons*. Rainfall and fertility are there as great as in the *Amazon Basin* or the tropical forests of the *Congo*.

Possibilities of Development.—It is to the monsoon countries that we must look for the future developments of Asia. The lofty *interior tablelands* and the low desert plateaux of the south-west offer little scope for development. The *steppes* of the Aralo-Caspian depression must remain pastoral so long as rainfall is scanty, and therefore will change little from generation to generation. The southern half of Siberia, under *Russian enterprise*, promises to rival the interior of Canada as a *wheat-growing region*, since it presents almost precisely similar conditions of climate and soil (see next chapter). Moreover, Siberia has thousands of square miles of *primeval forest* awaiting the lumberer. The mountains of her southern border are believed to be as rich in *minerals* as the lake-plateaux of the Canadian interior.

India and China are so productive that they support immense populations by agriculture alone. The minerals of India are secondary in importance, but those of China offer great scope for development.

European Powers in Asia.—*Russia* and *Great Britain* are the two most strongly established European Powers on the Asiatic Continent. *Japan* is entering the race for territorial expansion. Russia, Japan and Great Britain await political developments in China where, sooner or later, the opening

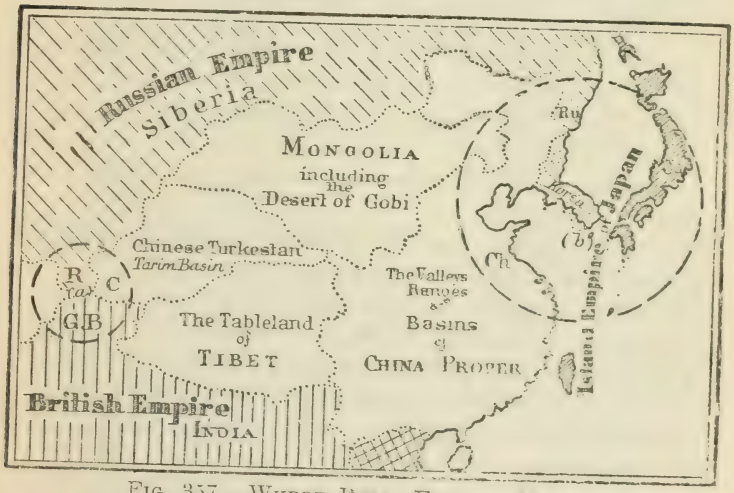


FIG. 357.—WHERE RIVAL EMPIRES MEET.
(*a*) The almost inaccessible Pamirs (*b*) The Yellow and Japanese Seas.

up of that country's mineral resources must lead to a struggle for supremacy.

Great Britain has a huge stake in the Asiatic continent in her Indian Empire.

Russia has actually pushed her empire to the Pacific seaboard, and has now turned longing eyes towards the warm waters of the Persian Gulf and the Indian Ocean. Already

her railways have penetrated to the frontier of Afghanistan on the north, as those of British India have on the south.

Persia offers a field for the rival interests of Russia, Turkey and Great Britain.

The rich basin of *Mesopotamia*, not now a garden but a fertile, swampy waste, whose outlet is toward the Persian Gulf and the Indian Ocean, offers a promising field for irrigation experiments, and already Turkish railways, constructed by German engineers and partly capitalised from Berlin, have pushed through the upper valleys of the basin from the shores of Asia Minor.

The ranges of *Indo-China* can never support immense populations like those found on the plains of India and China. Their wealth of timber (teak) and ores (especially tin) is as yet only partially developed.

Japan is advancing by leaps and bounds since her adoption of Western methods.

The *Philippines* may be expected to enjoy increasing prosperity as a colony of the United States.

The *East Indies*, in equatorial latitudes, can never be successfully colonised by Europeans, but British and Dutch traders, on their way to and from the Far East and the Antipodes, will continue to further the development of the Archipelago, by calling at its ports and gathering up its tropical produce.

CHAPTER II.

Climatic Conditions over the Continent of Asia. Three Strongly Contrasted Types. Bearing of Climate on Agriculture and Productions.

[Maps to be studied: Isothermal, Rainfall and Vegetation maps of Asia.]

Broad Climatic Conditions.—Asia resembles Africa and Australia in having no long arms of the sea penetrating far into the land. The peninsulas of India and Indo-China are, however, unrepresented by similar features on the two continents mentioned above. As in Africa and Australia the climates of the seaboard differ from that of the interior, so in Asia we have a marked contrast in climate in passing from the peninsulas of the Indian Ocean to the plateaux of the interior. It is comparatively easy and approximately accurate to divide the continent of Asia into **three broad climatic regions.** If we draw a line from *Aden* diagonally north-east across the map to *Pekin*, the capital of China, and another diagonal from *Perm*, in the Ural Mountains, to the same city of Pekin, we cut the continent up into its three major climatic divisions. North of the Perm-Pekin line we have the *sub-Arctic region* of Siberia merging into the truly Arctic climatic conditions of the long northern fringe of the continent. South of the Aden-Pekin diagonal

we have the *Monsoon* countries*, whose seasonal climate is better developed than in the case of any other continent. Within the wedge formed by the two diagonals we have that section of the continent which is least influenced by the ocean or winds driving in from the ocean. This third section is *the driest region* of the continent, and presents at one and the same time, and in close proximity to one another, the *highest tablelands* and the *lowest depressions* on the continent.

The isotherms for *January* indicate that the northern section, Siberia, experiences extreme cold in the depth of winter. In fact, the concentric arrangement of the lines around the village of **Verkhoyansk** suggests that this region is colder than the Pole itself in the middle of winter.

The *July* isotherms indicate tremendous heat, considering altitude,† on the tablelands of the middle section included between our chosen diagonals. In this region in July, places of any given altitude are hotter than similar altitudes on the peninsulas which lie to the south, or even on the islands which are situated about the Equator itself.

The monsoon countries are, of course, tropical in type, but they differ from the two divisions above referred to in showing only *slight* temperature variations between summer and winter averages. In these countries the seasons are marked by the distribution in time of the *rainfall* rather than by the varying length of day throughout the year. The climate is typically *equable*—most equable nearest the Equator, and diverging more from equable when we move into higher latitudes (China and Japan).

In the northern section, great *extremes* between summer and winter occur, Verkhoyansk (already mentioned) is as warm as Newcastle in July, but 80° F. colder in winter. The

* *Monsoon* is derived from the Arabic word *mausim*, meaning "season."

† Isotherms are everywhere reduced to sea-level—the numbers given stand therefore much higher than the actual summer average temperature.

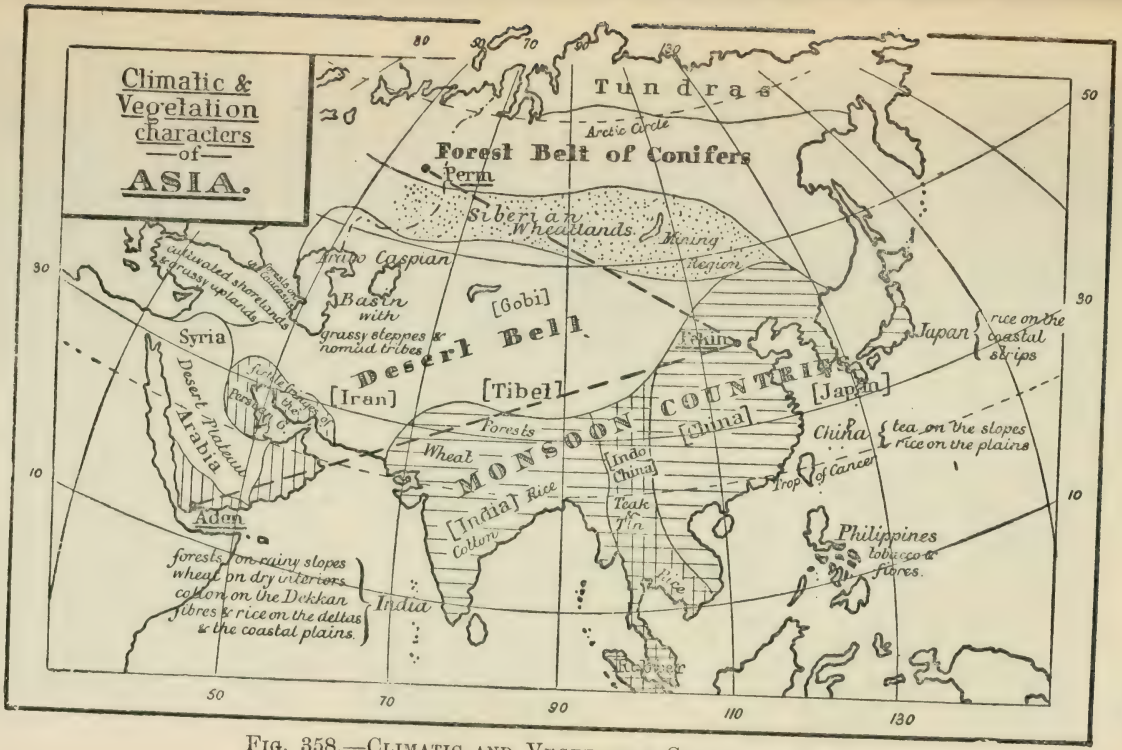


FIG. 358.—CLIMATIC AND VEGETATION CHARACTERS OF ASIA.

more marked extreme therefore is that of *cold*. In the middle section of the continent, it is the summer *heat* (again considering altitude) that is so exceptional. The summer isotherm, which forms a closed curve over this region, is that of 90° F. In winter, the average over the same region is about 60° F., or only 30 degrees colder.

The student will at once notice the *great range of temperature* in the Siberian section compared with that in the middle section. The range at Verkhoyansk reaches the enormous difference of 109° F., whilst that of the tablelands varies from 30 degrees on the tropic to 60 degrees on the Pamirs. It will at once be seen that this remarkable contrast is due, more than anything else, to the *difference between the length of the summer day and the winter day* in the two regions respectively. At Verkhoyansk, in latitude 67½° N., the average length of the summer day is 20 hours. Of course the length of the winter day is (24—20 hours).* It is the enormous difference in length of day that largely accounts for the enormous range in temperature. On the other hand, *Kabul*, the capital of Afghanistan, which stands about midway in the middle section of the continent, as divided by our two diagonals, is only 35° N. Such being the case, its summer day of 14¼ hours is only 4½ hours longer than its winter day (24—14¼ hours).

In the same way the *extremely equable conditions* of climate in the East Indies are largely attributable to the *almost constant length of the days* all the year round.

Readers of Part I. will be aware that *rainfall* affects *range* and *temperature* to a considerable extent, but its importance in this respect is secondary to the *astronomical factors* of the varying lengths of summer and winter days.

In the *northern section* rainfall is never excessive, and occurs more in summer than in winter. Any slight effect

* At midsummer the sun never sets for a few days. At midwinter it never rises for a few days.

it must have, therefore, will be in the direction of lowering the summer temperature. The absence of rain in the winter leaves nothing to modify the extreme cold due to the astronomical conditions of high latitude, viz., short winter days and a slanting sun.

In the *middle section* (except in Asia Minor, which can hardly be included since it has seas on three sides of it) rainfall is exceptionally low, many districts receiving less than five inches a year. Under such conditions, rainfall as an equalising agent is practically negligible.

In the peninsulas of *India* and *Indo-China* summer is the rainy season, and winters are comparatively dry, if we except Ceylon. The influence of rainfall is, therefore, to reduce summer temperatures rather than to raise winter temperatures. Ceylon and the East Indies have *two* rainy seasons, corresponding to the two monsoons. The reason for this will be clearly indicated in treating more fully the two regions referred to (Chapter VII.). Nowhere in Europe is the rainfall so great as in these monsoon countries.

The **three great races** of Asia had, roughly speaking, their origins in the three broad divisions outlined,—the *Mongolians* on the southern edge of the northern belt; the *Caucasians* in the dry interior, and the *Malays* in the archipelago of the monsoon belt.

From these introductory remarks, we will proceed to consider the three regions in greater detail, without necessarily keeping to the rigid lines of the diagonals indicated.

Our **northern section** includes the long gradual slope draining to the Arctic seas from the northern rim of the central tableland. This practically corresponds with Siberia. Along with Siberia we may take the Manchurian province of China. The slope is toward the north, and therefore is at a disadvantage with regard to the incidence of the sun's rays. A northern slope receives less sun heat than a plain in the same latitude.

whilst a southern slope receives more than a plain, and so gains an advantage in climate. Taking the July isotherms for this region, that of 80° F. forms the southern boundary, whilst that of 40° F. follows the trend of the northern shore. The isotherms are practically parallel, showing a *gradual fall in temperature* from upland to sea-board. Over the Pacific border these lines bend suddenly southward, indicating that, in summer, places on the sea-board are *cooler* than places in the interior having the same latitude.

The winter isotherms show less parallelism. They tend to concentrate round the "*pole of cold*" already mentioned

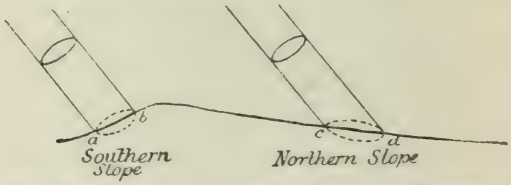


FIG. 359.—DIFFERENCE OF HEATING EFFECT.

Two equal bundles of the sun's rays falling respectively upon southern and northern slopes in Siberia.
a, *b*. Greater heating effect, owing to smaller area.
c, *d*. Not made so warm since area larger.

at Verkhoyansk; thus in mid-winter the interior of Siberia is colder than either the Pacific or the Arctic sea-board.

The July isotherm, 70° F., closely corresponds with the track of Siberian development from the *Urals* to *Lake Baikal*, whereas beyond Lake Baikal the Trans-Siberian Railway follows a direction similar to that of the 75° F. isotherm. The corresponding isotherm of *Great Britain* in equivalent latitude is 60° F., so that Siberian summers are considerably *hotter* than those of England, where the latitude is approximately the same. Our English winters in no way approach the severity of those of Siberia. It is to the *Canadian interior* we must look for a real comparison with Siberia. The summer isotherm of 70° F. passes through *Omsk* and also through *Winnipeg*. Canada has its pole of cold in the region of

Victoria Land and *Boothia*, which (by coincidence) is also the *Magnetic North Pole* of the earth. The cold, however, is not so pronounced as in Siberia. The winter isotherm for Winnipeg is 0° F. That of Omsk is the same.

Comparison with the Canadian Dominion.—The student will not be surprised to learn that as Siberia much resembles the Canadian interior in its north-flowing rivers, its dry climate, its summer and winter temperatures, it is developing along similar lines, as a *granary* for the Empire of Russia, of which it forms a part. North of the line of development stretches the broad belt of sub-Arctic *forest*, precisely similar to that of Canada. The trees are *coniferous*, and include the *pine, spruce, larch, and fir*. Beyond, stretch the *tundras* of the coastal belt. Here one meets with the hardy, short, stiff-set *Lapps* and *Samoyeds*, whose domesticated animals are the *reindeer* and the *dog*, and whose staple trade is in *fish* and *fur*.

The **middle section** of the continent, according to our mode of division, includes the high tablelands of the desert belt and the low steppe-lands of the Aralo-Caspian inland-drainage area. This section affords better comparisons with the *interiors of Australia and Africa* than with the North American continent, though comparisons are not wanting with the latter. It is remarkable for the number of *arid tablelands*, and *semi-arid salt basins* in the hollows of those tablelands. Along with the *highest* tableland in the world, and in close proximity to it, we have the *lowest* inland depression of any size.

The **Pamirs** form the core of the uplands from which radiate many lofty ranges, which form the rims of the table-lands. The larger and loftier plateaux spread toward the east. The lower plateaux extend toward the west. The most conspicuous of them all is that of *Tibet*, with the long wall of the *Himalayan Mountains* for its southern rim and the *Nanshan Range* for its northern edge. To the north lie the

Tarim Basin and the Gobi desert. The Tarim basin derives its waters from the snows of the Pamirs. The *Gobi Desert* has no streams, and well deserves its name of the "Sea of Sand." The Tarim River ends in *Lob Nor*, a fresh water lake, which has shifted its position in the course of time, probably under the influence of sand-storms. The lofty *Tian Shan Mountains* form the northern wall of the basins.

The dissected *Kobdo Plateau*, which culminates in the *Altai Mountains*, separates the desert of Gobi from the fertile plains of Siberia.

To the west of the Pamirs we have the strongly contrasted units, the *Plateau of Iran* and the deep *Aralo-Caspian Depression* of Russian Turkestan.

A further striking contrast is presented in the trough of *Mesopotamia* and the tablelands of *Arabia*.

Dividing the one pair of contrasted regions from the other, we have the mountain wall of the *Armenian-Kurdistan Highlands*. In the regions under consideration it is only this mountain wall that receives any considerable amount of rainfall. The only rivers of importance, therefore, are the streams of *Turkestan*, which find their source in the snows of the Pamirs, and those of *Mesopotamia*, which rise amid the Armenian highlands.

The *Plateau of Iran* is remarkable for the number of low basins it supports, each with its uncertain stream and brackish lake. If these may be compared with the Tarim Basin east of the Pamirs, the impassable tableland of Arabia can only be compared to the sand-waste of Gobi.

The *Aralo-Caspian Depression* presents a striking contrast to the *trough-like* depression of Mesopotamia and the Persian Gulf. The one finds its outlet in an ocean, the other drains to inland seas. The basin of Mesopotamia, opening southward, is, of course, hotter than that of Turkestan, opening northward; it is some 10° F. hotter in summer, and quite 40° F. warmer in the winter. The Aralo-Caspian Basin is a

typical *steppe-country*—grass-lands without trees, not unlike the *veld* of South Africa. *Stock-raising* is the principal occupation of the farmers who inhabit the basin.

The *Kirghiz sheep* is remarkable for its yield both of wool and of tallow. The banks of the two rivers which drain to the Aral Sea (*Amu* and *Syr Daria*) are the only lines of communication.

The warm basin of Mesopotamia is comparatively unhealthy. It is possible that *irrigation* might make the rich soil once more habitable and attractive; but the banks of the rivers are more remarkable for their numerous memorials of by-gone civilisations than for their present prosperity.

The basins of the Iran Plateau offer little scope for development.

Two-thirds of the Arabian tablelands remain still unexplored. It is only along the *coast-fringe* that much development can be looked for.

This middle section of the continent, by reason of its infertility can only support *nomad tribes*, tent-dwellers, whose domesticated animals are the *horse*, the *camel*, the *sheep*, and the *goat*.

In striking contrast to the Siberian plain and interior tablelands is the **Monsoon Region** of the peninsulas and archipelagos on the south-eastern border of the continent. Siberia is for many months of each year in the grip of winter cold; the tablelands are parched with summer heat. In neither does the rainfall reach a maximum of 30 inches a year. In the monsoon regions rainfall reaches the high annual average of 75 inches over very considerable tracts of country.

It is the *South-West Monsoon* that brings the heaviest rains. The North-East Monsoon scarcely affects India, and the North Monsoon adds only slightly to the rainfall of China and Japan. The *Nilgiris* of South India, and the outlying mountainous island of Ceylon benefit by the moisture picked

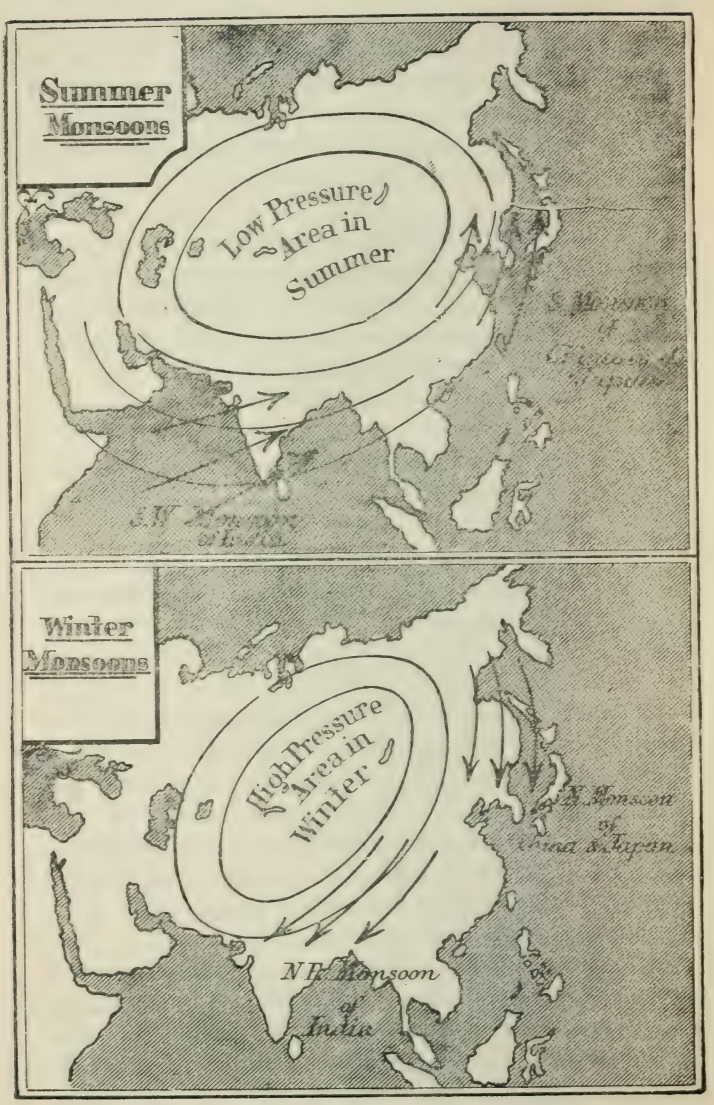

Summer Monsoons
Low Pressure Area in Summer
S.W. Monsoon of India
Winter Monsoons
High Pressure Area in Winter
N.E. Monsoon of China & Japan
N.E. Monsoon of India

FIG. 360.—SUMMER AND WINTER MONSOONS.

up by the North-East Monsoon on its way across the Bay of Bengal. The northern slopes of the islands of the East Indian Archipelago are indebted in the same way to the North Monsoon of the China Seas.

Otherwise the principal rainfall occurs on the slopes which are presented more or less normally to the South-West Monsoon. Such slopes are the *Western Ghats*, the steep face of the *Himalayas*, and the parallel ranges of *Indo-China*.

The Summer Monsoon.—When the sun is over the neighbourhood of the Tropic of Cancer (May to July), the *middle of the continent* (as previously divided) is a *region of low pressure*, and the general tendency of circulation on the borders of the continent is *counter-clockwise* around this low pressure area, in accordance with the general laws of cyclonic air-movement (*see* Section I.); in this way the Summer Monsoon has a *south-west* direction in the Indian Ocean and a more *southerly* direction in the China Seas. As a result, China and Japan both benefit by the Summer Monsoon.

In the winter, the *high plateaux* to the east of the Pamirs are a centre of *high pressure*, from which cold air moves outward with a gentle tendency to *clock-wise* movement on the oceanic borders of the continent, in accordance with the laws of anti-cyclones (*see* Section I.). The Winter Monsoon is therefore a *north* wind in the China Seas and *north-east* wind in the Bay of Bengal. Summers are very warm over the whole monsoon region. Japan is 15 degrees warmer than Great Britain in summer, China and India are from 20 to 30 degrees hotter, varying with latitude.

The *range of temperature* in India and Indo-China varies from 5 degrees in the peninsular region to 30 degrees on the plains of India and China. Whilst the range in Great Britain is only 20 degrees, that in Japan is 40 degrees. The climate of Japan, therefore, presents *stronger contrasts* than

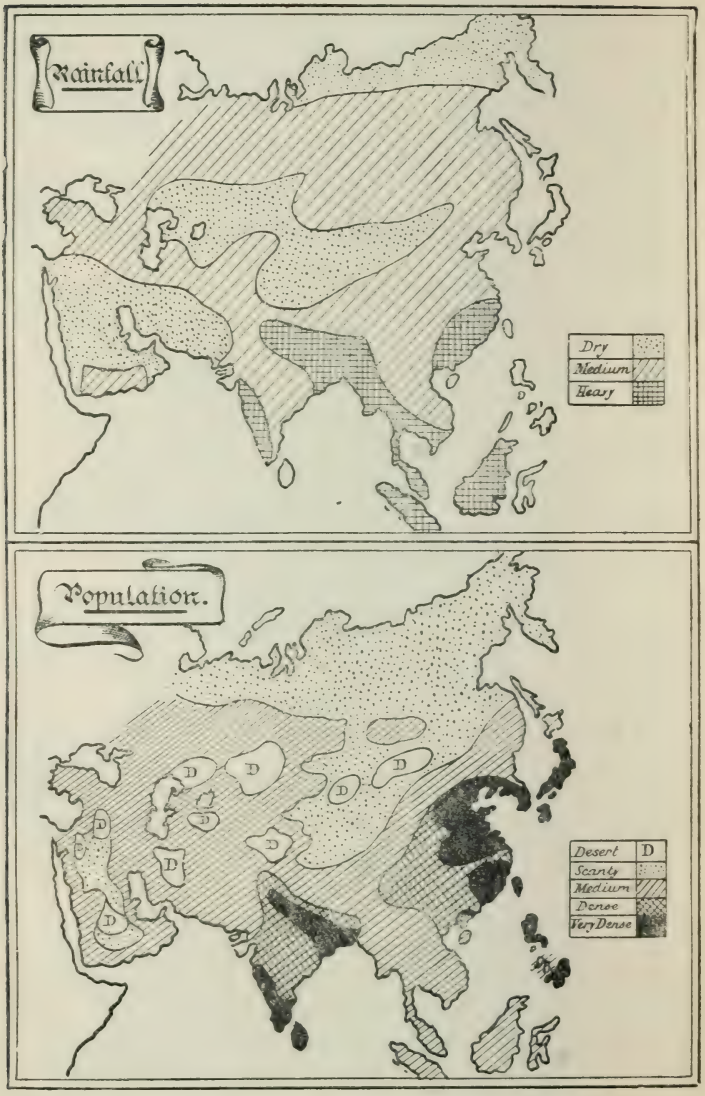


FIG. 361.—RAINFALL AND POPULATION IN ASIA.

that of the British archipelago, though its average temperature is very little higher.

Tropical types of vegetation flourish on the *Western Ghats*, in the *Ganges Basin*, on the shore-lands of the *Indo-Chinese Peninsulas*, and everywhere in the *East Indian Archipelago*.

Except along the southern shore of China proper, tropical types do not occur in the Chinese Empire. The basins of the *Yang-tse-kiang* and *Hoang-ho* are poor in forest, but well adapted to cultivation, especially in the "loess" regions of the lowlands. *Japan* and the neighbouring peninsula of *Korea* have forested slopes. The agricultural wealth of these countries consists largely of *tea*, *coffee*, *cotton*, *rice*, *fibres* (hemp and jute) and *tobacco*.

Teak is abundant in the forests of South India, Ceylon and Indo-China. *Rubber* plantations are promising exceptionally well in the East Indian Archipelago. *Tobacco* is a speciality of the Philippines, and *opium* of the plains of India and China. *Silk* is a valuable product in all these countries, the mulberry-tree being everywhere plentiful. *Rice* thrives on damp lowlands, even as far north as latitude 40°. *Tea* and *coffee* plantations occupy the warmer slopes. The coastlands are in many places fringed with groves of the *coco-nut palm*.

Of all the monsoon countries, the Indo-Chinese peninsula offers most difficulties in development, being very mountainous and having no plains, except the deltas and flood-plains of its great rivers (*Irawadi*, *Salwen*, *Mekong*). India and Japan have broad expanses of plain, with deep navigable rivers.

Agriculture is the principal pursuit of the myriad peoples of the plain. The distribution of population is, therefore, at present, determined by agricultural possibilities. As this depends on rainfall in countries of tropical and sub-tropical latitudes, it is noticeable here, as in Africa (*see* Section VI.,

Africa," page 720), how strikingly the *distribution of population* coincides with the *distribution of rainfall.*

The *Malay* races have peopled the southern peninsulas of the continent, in addition to the islands of the archipelago. *Caucasians* have spread down upon the fertile plains of India, and *Mongolians* have descended upon the rich lowlands of China until Caucasians and Malays mix on the peninsulas of India, and Mongolians with Malays on the shores of Cochin China.

CHAPTER III.

Historical and Commercial Development of Asia. Trade Routes Past and Present. Lines of European Advance.

The ancient civilisations of the Continent of Asia preceded those of Europe by many centuries. The oldest of which we have any record is that of the peoples who inhabited the fertile basin of *Mesopotamia* and the low plateau stretching from that

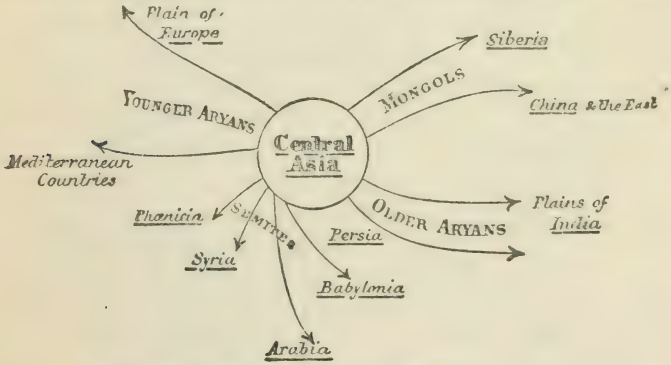


Fig. 362.—Migration from Central Asia.

basin to the lofty Pamir tablelands. From these regions constant migrations took place along radial lines—westward to the *Mediterranean* countries (younger Aryan and Semites), eastward to the plains of *India* (older Aryan), and northward

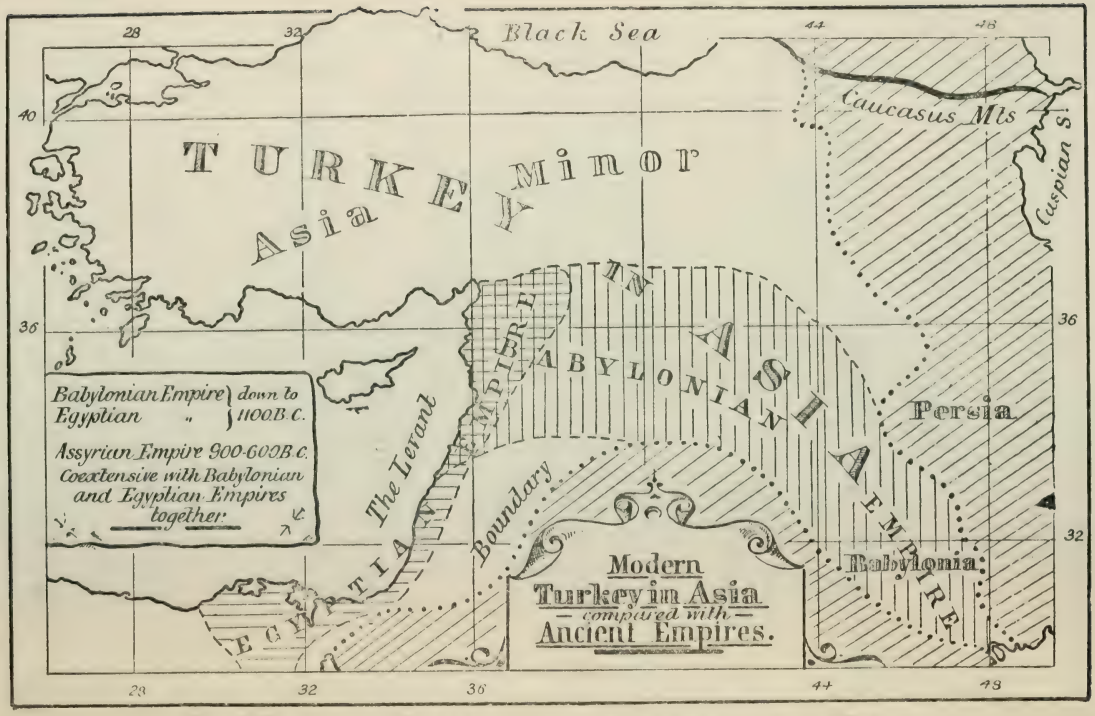


FIG. 363.—MODERN TURKEY IN ASIA COMPARED WITH ANCIENT EMPIRES.

to the lowlands of *Russia* (Mongols) on the one hand and the *Asiatic plateaux* (Mongols) on the other.

China, Korea and Japan are the modern representatives of the Mongol or Tartar branch, which presents many striking characteristics in contrast to the western types—the Aryan and the Semitic.

The **Semites** dwelt in the valley of Mesopotamia and on the plateau and shorelands of Arabia. They gave rise to the ancient *Babylonians*, the *Assyrians*, the trading *Phœnicians*, the nomad *Arabs*, and the *Hebrews* of our Old Testament Scriptures.

To the **Aryan** race belonged the *Medes* and *Persians*, who gradually mastered the Semitic peoples and extended their empire over Asia Minor, Mesopotamia, the plateau of Iran and even the plains of the Indus. The later Aryan migrations (to Europe) came by way of the Mediterranean and gave rise to the *Kelts*, the *Latins*, and the *Greeks*. Later came the *Germans* and the *Teutons* across the European plain.

Eastward the Aryans gave rise to the *Hindus*, and westward to the peoples of Europe.

These migrations from the Asiatic "cradle of civilisations" gave rise to the now very distinct peoples of the two continents—the *Chinese* and the *Japanese* beyond the central plateau, the *Hindus* on the plains of the Indus and the Ganges, the *Turkomans* in Central and Western Asia, and the *Slavs* on the plains of Russia.

Historical records in *Mesopotamia* reached back 4000 years before the Christian Era. *Babylon*, the great focus of civilisation in this fertile basin fell only some 550 years before the opening of our era. The once fertile basin is now a deserted land, with many of its ancient cities buried beneath the sands, but its children have spread to every shore of the Eurasian continent.

[Egyptian civilisation, dating back 6000 years B.C., and the Greek and Roman Empires have risen and fallen in

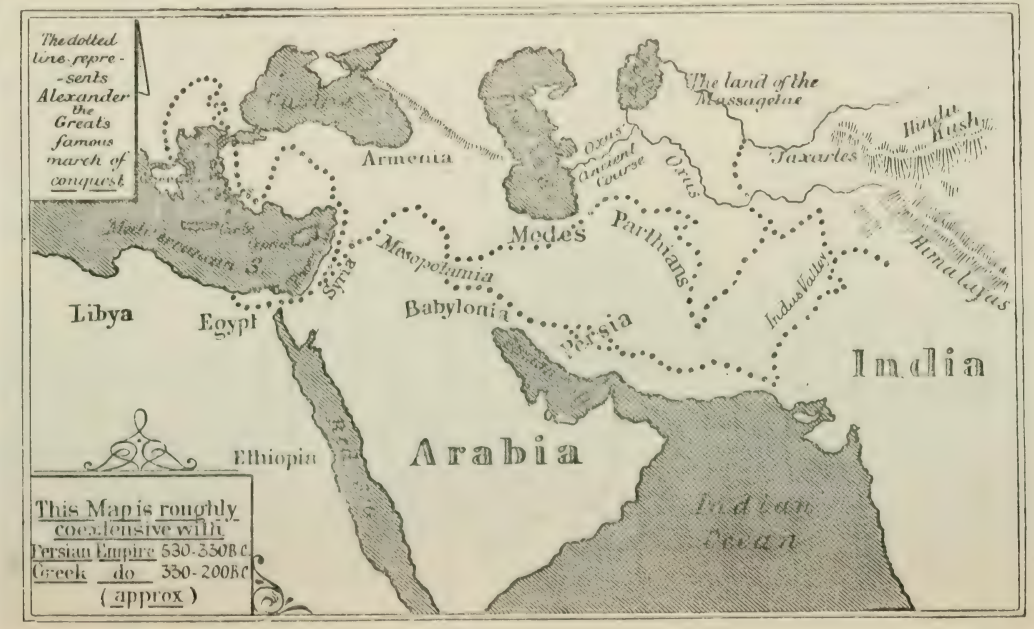


FIG. 364.—THE ASIATIC "CRADLE OF CIVILISATIONS"—THE SCENE OF MANY EMPIRES.
[Egypt was another centre of early civilisation.]

turn on the shores of the Mediterranean, and the provinces of Rome have become the nations of modern Europe.]

The Empires of *China* and *India* number their inhabitants by hundreds of millions upon the rich alluvial plains of their great rivers. The history of Chinese civilisation carries us back more than 4000 years. The Aryans were in India quite ten centuries before Christ, but her recorded history may be said to begin with the invasion by Alexander the Great, in 327 B.C.

TRADE ROUTES PAST AND PRESENT.

The **Phœnicians** were the greatest traders amongst these ancient peoples; they had ports (*Tyre* and *Sidon*) on the Mediterranean Sea, and trading colonies as far west as the Atlantic border (*e.g.*, on the site of *Cadiz*), as well as ships upon the *Red Sea* and the *Persian Gulf*, trading with India and the east coast of Africa. They brought together the peoples of the east and west. They founded the trading centre of *Carthage*, midway on the Mediterranean shore of Africa. In addition to their trading fleets (the Phœnicians were traders, not conquerors) they used several overland routes—*westward* along the valleys of Asia Minor, *eastward* across the plain of Mesopotamia, *southward* along the shore-lands of Palestine to Egypt.

The **Portuguese** were the first modern Europeans who touched Southern China with their trading fleets, in the days of the "Age of Discovery." Next followed the **Dutch**, who, in the seventeenth century, supplanted the Portuguese as merchant-traders and navigators and left a very prominent mark upon Southern Asia, in their colonies among the islands of the East Indian Archipelago. **France** and **Great Britain** soon appeared as rivals of the Dutch and Portuguese for the trade of the Indian Ocean, and rivals of each other for supremacy in India, but the immense colonising

energy of the British, accompanied by their supremacy on the seas, has left Great Britain predominant.

Overland Trade Routes existed for centuries before "the age of discovery" and the era of navigation:—

(*a*) Between Russia and China along the *southern fringe of Siberia*;

(*b*) From the Steppes of the Aralo-Caspian Basin, by *passes in the Pamirs*, to Kashgar on the Chinese side of the frontier; and

(*c*) From the Mediterranean shores, *by way of the Euphrates*, to the distant plains of India.

Modern Development.—The modern development of eastern trade routes, by which the railway supersedes the pack-horse, the yak, the mule and the camel, is going on apace. The *close proximity of these routes to the ancient* roads is striking. The lines are those "*of least resistance.*"

Russia has taken a foremost place in this development. She has carried a line, more than 6,000 miles in length, from her capital in Europe (St. Petersburg on the Neva, flowing into an arm of the Atlantic) to her eastern port (Vladivostok on a sea of the Pacific). Part of the line traverses Chinese Manchuria. She has pushed forward into the interior of Asia, to the *Persian frontier* on the south and the *foot of the Pamirs* on the east. The low plateau of Persia alone shuts her out from the warm waters of the Indian Ocean, and already she has negotiated *telegraph communication* with ports and cable stations on those waters.

Even **Turkey** seems to be renewing her energies and opening up a new era of development, back to the east whence she came. Two lines have been carried by German engineers across the plateau of Asia Minor (*Scutari* to *Eregli* and *Smyrna* to the *Taurus*) for more than half its length, and projects are being considered to carry these to *Suez* (viâ *Damascus*) and the *Persian Gulf* (viâ *Mosul* and *Baghdad*). Schemes are also being submitted for the *irrigation* of the

neglected but immensely fertile basin of Mesopotamia, and it seems within the range of possibility that before many years have passed, the ports of the Persian Gulf will assume considerable importance.

Great Britain is developing the railways of India. The centres from which these radiate are naturally the three *capitals* of the three Presidencies of the Empire—*Calcutta*, *Bombay*, and *Madras*. Another equally important railway centre is *Delhi*, the ancient capital of the Moguls. The north-east frontier of India is the line of most *strategic* importance, and branch lines have been carried along the valleys of the frontier to the fortified stations, which are the outposts of the Empire. Between them and the termini of the Russian railways lie only a few hundred miles of difficult country. In the extreme *north-west* the frontiers of Russia and Great Britain are separated by only one range of the Pamirs. The linking of Russian and British railways across the neutral country which divides them would bring Calcutta within *ten or twelve days' journey* of St. Petersburg, Berlin, Paris and London.

China is only just beginning railway construction. Her pioneer railways were ruthlessly torn up by fanatical haters of Western civilisation. A north and south line from *Pekin* to *Hankow* has been constructed nearly as far as *Canton;* but through all the centuries of her civilisations, China has depended chiefly on her great *rivers* and the *Imperial Canal.* She cannot much longer afford to do so. Her mineral wealth is enormous; she has 50,000 square miles of *coal-fields*, and the coal is excellent in quality; it cannot much longer remain unworked. *Iron* of excellent quality is found on the coal-fields. Mining possibilities are considerable in the dissected plateau of *Kobdo*, on the northern frontier.

The Chinese province of *Manchuria* is already linked with the Russian Trans-Siberian Railway.

Great Britain has carried a line from *Rangoon*, on the delta-lands of *Burma*, right up the narrow valley of the Irawadi to the *Chinese frontier*, not many miles from the navigable upper reaches of the Yang-tse-kiang, the most valuable of Chinese rivers.

Japan has most of her towns on the coasts of her islands, she has not, however, been content with steamship communication, but has spread a *network of railways* over the *shore-lands*, to link up her busy towns.

Three historical incidents of special interest to Europeans may be noted:—

(1) **The invasions of Asia by Alexander the Great,** who pushed his empire to the *Indus*, on the east, and the *Jaxartes* on the north, in the fourth century before Christ.

(2) The remarkable **travels of Marco Polo**, the Venetian, who penetrated the plateau of Central Asia and reached the plains of China by an overland route as early as the thirteenth century of our era. The Venetian was for seventeen years at the court of Kubla Khan, the Chinese emperor, whose name has been made familiar to us in the poem of Coleridge.

(3) The **recent travels of Dr. Sven Hedin** have served to prove the wonderful accuracy of Marco Polo's writings on his travels.

TRADE ROUTES OF ASIA.—EXPORTS AND IMPORTS.

The Siberian Railway serves chiefly for the interchange of goods between the east and west of the Russian Empire. It is important as a means of *transport for Russian troops* required on the Pacific frontier and as a *colonising agent* for the expanding population of Russia. As a world's highway it has still to develop, but there seems every probability that it will serve the Old World much in the same way as the *Canadian Pacific Railway* serves Canada and the New World. The goods traffic of the two railways will be very

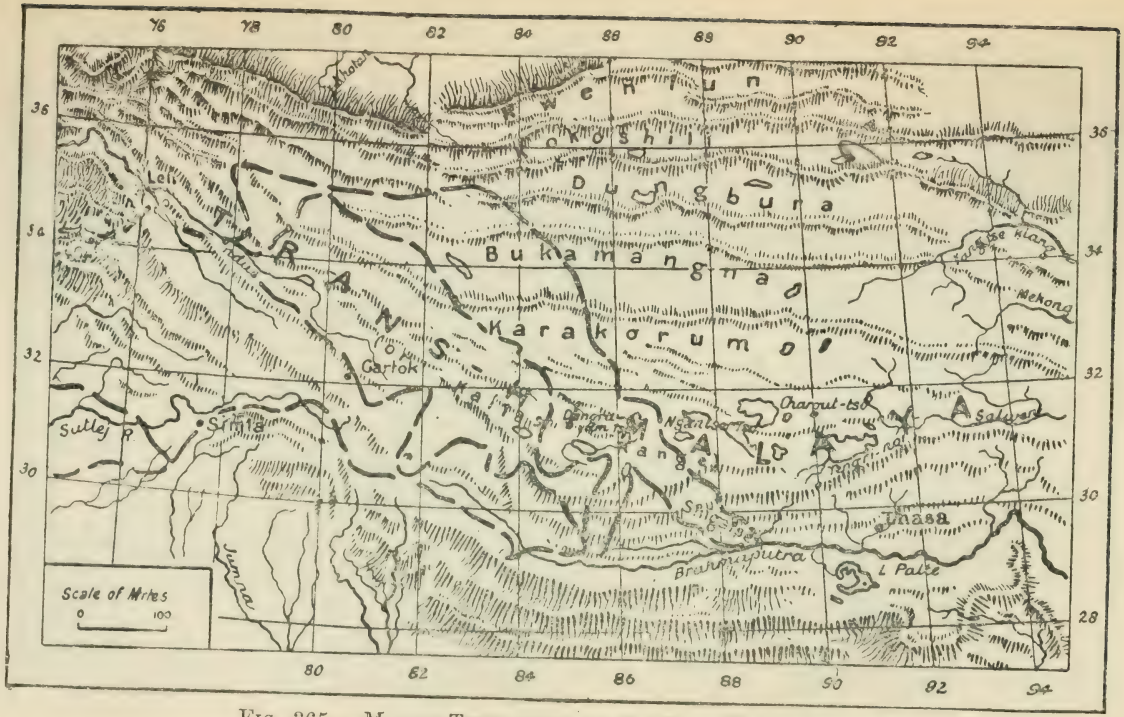


FIG. 365.—MAP OF TIBET SHOWING DR. SVEN HEDIN'S ROUTE.

[The barred black line marks his journey.]

similar in character. *Wheat* and *flour*, *timber* and *pulp* will for some time be the principal freights. As mining developments proceed in the region of *Lake Baikal* and the upper valley of the *Amur*, as well as in the *Ural Mountains* on the European frontier, *machinery*, *ore*, and *specie* will considerably add to the traffic of the line. Along the railway China will send her *tea* as formerly she sent it by the post-road.

The **Trans-Caspian Railway** and the *Tashkent* line pick up the *wool*, *tallow* and *hides*, which are the natural exports of the steppe-lands in the Aralo-Caspian Basin, and also *cotton* and *tobacco*, which are proving successful on the banks of the *Syr Daria* and the *Amu Daria*. Caravans from the central Asiatic plateaux bring the products of Central Asia from *Kashgar* in Chinese Turkestan to *Andijan* and *Khokand* on the railway.

The great trade-highways to the east are still the *sea-routes* of the Suez and the Cape. The Suez traffic has largely superseded the former *caravan trade*, which made the prosperity of the Phœnicians and the Arabs in the days when the Mediterranean was the home of European civilisations, and the Baltic and the British seas were as yet undeveloped. From *Aden* steamers diverge for *Karachi*, *Bombay* and *Colombo*. Karachi is the gate of the Indus Basin and the upper Ganges. Bombay has direct communication with Calcutta and all the cities of the lower Ganges. Colombo is the diverging point of several routes:—

(*a*) To the ports of the Bay of Bengal,
(*b*) To the Far East, and
(*c*) To the Antipodes.

India's chief exports are *cotton* and *rice*, *coffee* and *tea*, *wheat* and *fibres*.

Burma and the Malay Provinces yield not only *tobacco* and *rice*, but also valuable supplies of *teak*, *tin*, and *petroleum*.

FIG. 366.—TRADE ROUTES OF ASIA.

Singapore and **Hong-Kong** are the greatest *entrepôts* of British trade in the Far East. Singapore gathers up the produce of the British possessions in the *East Indian Archipelago*. Hong Kong has done the bulk of our trade with *China* for the last fifty years.

Many ports of China have been opened up by treaty to foreign trade. From these China exports her *silk*, *tea* and *hides*, which are, in the order named, her principal exports. From India she receives in return *cotton* and *opium*. The peninsulas of Indo-China send her *rice*. The oil-wells of Pennsylvania yield her *imports of petroleum*. The principal bases of Chinese trade are **Shanghai**, **Fuchow** and **Tientsin**. The *Yang-tse-kiang* is an exceedingly valuable water highway, being navigable for some 1,600-2,000 miles (to the foot of the central plateau) and draining a very productive valley, which opens out into several fertile basins. The other great river of China, the *Hoang-ho*, is navigable for a much shorter distance, and is much more liable to dangerous *floods*, which seriously impair its usefulness, and endanger life. It has changed its course nine times in 500 years.

The *Imperial Canal* follows the lowlands from *Pekin* to the head of the Yang-tse-kiang estuary.

The peninsula of *Korea* is under Japanese protection, and has an important port in **Fusan**, at the southern terminus of the railway which follows its coastline. Fusan is the nearest point to Japan.

Yokohama is the first port of the Japanese Empire, and the outlet for *Tokio*. **Nagasaki** is Japan's nearest port to China, if we except the distant island of Formosa, which became a Japanese possession in 1895. Japan has steamship communication with American ports on the Pacific sea-board, and viâ *Singapore* and *Colombo* with the *Red Sea route* or the *Cape route* to Europe.

Great Britain and **Germany** hold the stations of *Wei-Hai-Wei* and *Kiao-chau* respectively on the *Shantung* peninsula.

France has secured the eastern half of the Indo-Chinese peninsula, with the valuable lowlands of *Cambodia* and *Cochin China*.

The United States have in recent years secured Asiatic interests by gaining possession of the *Philippine Archipelago*. The chief port of the Archipelago is *Manila*, some 650 miles south-east of Hong Kong, and conveniently placed for ships proceeding from Singapore to any of the great ports of China or Japan.

The seas of the East Indian Archipelago serve as a veritable highway for steamers proceeding to the Antipodes. The British port of *Singapore* stands at the western entrance. *Batavia* is the principal port in the Dutch possessions, which lie on either side of this highway. The *Torres Strait* at the eastern gate has British territory on either shore.

CHAPTER IV.

Our Empire in the East: India, Burma, Ceylon, and the Straits Settlements.

CO-ORDINATES OF—

BOMBAY:	73° E., 19° N.	CALCUTTA:	88° E., 22½° N.
MADRAS:	80° E., 13½° N.	SINGAPORE:	105° E., 2° N.

India and Burma are shut off from the rest of the Asiatic continent by the high ranges of the *Hindu Kush* on the west, the long barrier of the *Himalayas* on the north, and the parallel ranges of Burma on the east.

They open to the south, *i.e.*, to the *Equatorial belt.* A tropical ocean washes their shores. Rain-winds blow in from this tropical ocean.

India is largely lowland in character. Apart from the lofty mountain frontiers, only the *Nilgiris* and the culminating peaks of *Ceylon* attain to a fully mountainous character. The *Dekkan* is a triangular plateau of considerable height on its western edge. The northern plains form a broad belt of plain with a low watershed of S.W.-N.E. trend, dividing them into two distinct drainage areas.

The triangular plateau is within the Tropics. The two river basins (*Indus* and *Ganges*) are outside the Tropic of Cancer, with the exception of the Ganges delta. **Burma** is

just within, whilst **Ceylon** is anywhere less than 10° lat. (N.) from the Equator.

The **Straits Settlements** lie even nearer the Equator; *Singapore*, the chief station in the Settlements, is practically on the line.

India and Burma together cover nearly 1,000,000 square miles, and support a population of over three hundred millions. The high average for so large a country (300 per square mile) is due to the *fertility* of the country, and not to manufacturing industries, for agriculture is the staple occupation of the people, and the land is the main source of revenue.

The average latitude of India is roughly the same as that of *Africa south of the Zambesi* and *Australia*.

The difference of climate and fertility between these similar regions and India is due to two dominating factors:—

(*a*) The *mountain-barriers* shutting India out from the cold influences of the north, and acting as rain-barriers to precipitate the rainfall on the Indian side of the ranges.

(*b*) The presence of an *ocean on two sides only*, whilst South Africa and Australia are open to oceanic influences from three and four sides respectively.

These two factors combine to give the "*monsoon type*" of climate so characteristic of the southern peninsulas of Asia.

Physical Structure of India.—The geology of India in its broad outlines is very simple, and serves to explain the physical configuration of the country. The *Dekkan* is an ancient crystalline crust-block standing apart from the continental plateau of South Asia. *Ceylon* is a detached outlier of the block. The slope of this ancient plateau is gentle toward the east; the higher edge is along the western coast. The Nilgiris and Ceylon have the highest points of the plateau.

Drainage to the east coast is the general rule, but the outpouring of an immense *lava-sheet* in Tertiary times has

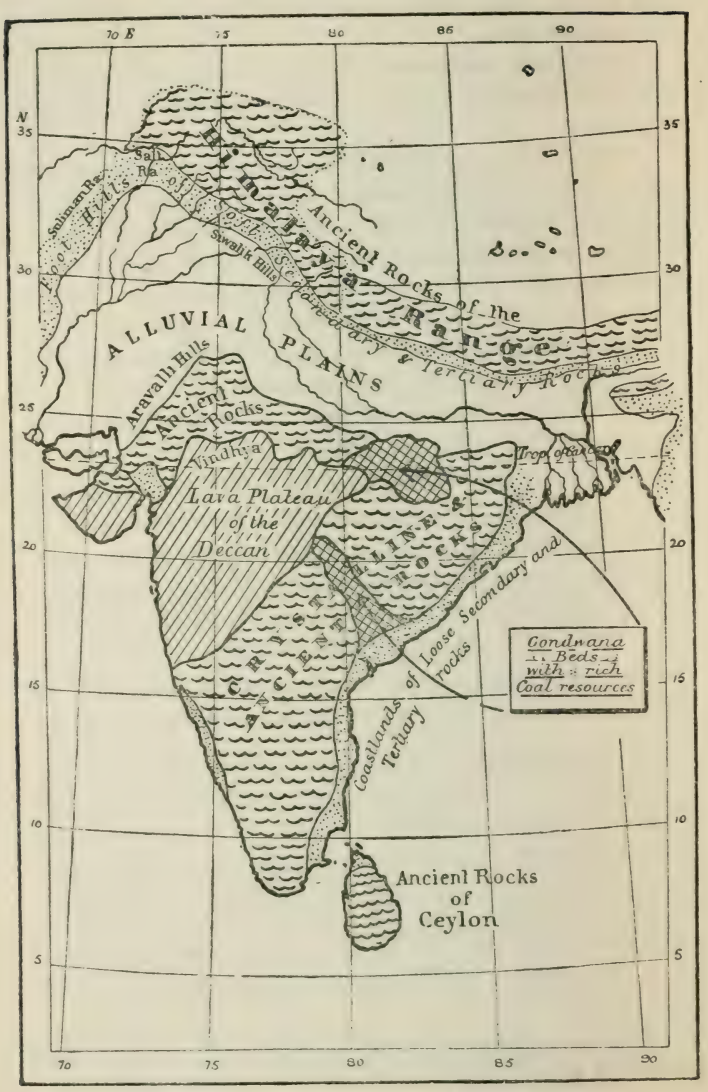


FIG. 367.—OUTLINE GEOLOGICAL MAP OF INDIA.

modified the drainage in the north-western angle of the triangular plateau. Two rivers (*Nerbudda* and *Tapti*) flow westward over the basalt to the *Gulf of Cambay*, whilst the remainder (*Mahanadi*, *Godaveri*, *Kistna*, etc.) find their way to the *Bay of Bengal*.

The central belt of the Himalayan range is also crystalline, but is not of the crust-block type. The *Himalayas* are a young mountain range, and these ancient crystalline rocks are exposed as the result of upfolding. Involved with them in the folding process are rocks of every geological age; these form the outer ranges and *foothills* which follow the general trend of the culminating ridge.

The best known of these foothills are the *Salt Range* and the *Siwalik Hills* in the Punjab.

The broad belt between the folded ranges of the Himalayas and the northern edge of the Dekkan crust-block (*Aravalli Hills*, etc.) is infilled with alluvial sediments, the youngest geological formations. A fringe of similar sediments runs along the shore-line of the Dekkan border of the *Bay of Bengal*. Odd patches occur also along the *Malabar coast* at the foot of the *Nilgiris* and *Western Ghats*.

The broad alluvial region of the north is termed the *Indo-Gangetic Plain*. The *Indus* gathers up the many streams of the western section; the *Ganges* carries even more water from the innumerable streams of the rainier eastern plain. Between these well-watered regions occurs the low desert tableland of *Thar*. The Indus valley has *low rainfall*; its streams gather their water from the snows of the Himalaya mountains; the Ganges basin is a region of *excessive rainfall*, and therefore of abundant streams.

Coalfields of the "Gondwana type" occur on the Dekkan; one of these forms the upper basin of the *Son*, a feeder of the Ganges; the other forms the lower valley of the *Godaveri*.

Both Indus and Ganges bring down heavy loads of detritus, and are building up huge deltas. The rocks of the foothills

are exceptionally soft, and liable to heavy denudation. The Ganges, as one would expect, has the greater delta.

From what we have said, it will be clear that, for detailed study, India can be divided conveniently into the following geographical units :—

(*a*) The Indus Basin.
(*b*) The Ganges Basin.
(*c*) The Dekkan, South India and Ceylon.
(*d*) Burma.

(*a*) **THE INDUS BASIN.**—The Indus, in one respect at least, recalls the Nile. In its lower course it practically receives no tributaries; in its upper course many streams of considerable volume coalesce in one grand river. The longest of these contributing streams gives it name to the lower river. The tributaries of the Indus from the west are of slight importance as rivers. Their gorges, however, have immense strategic value as *passes* through the barrier of the *Suliman Mountains* to *Afghanistan*.

The Indus itself rises away back in the central folded region of the Himalayas,* only a few miles from the *Sanpu* (or Brahmaputra), which takes a directly opposite course along the same fold (Kashmir). It flows along the trough in a new direction until it turns a right angle at *Gilgit*, and escaping through a gap in the ranges, follows the foot of the Suliman Mountains, to pour its waters by many distributaries into the Arabian Sea. The region of Gilgit (Chitral) is one of complicated mountain structure; here the folded ranges of the *Hindu Kush* abut on those of the *Himalaya*; the outcome is a complex of *zig-zag valleys*.

The wall of the Himalayas, which shuts off the upper Indus from the alluvial plain, gives rise to many streams which converge on the plain, and contribute their united waters by one stream to the Indus. The triangular plain over which ey flow is called the *Punjab* (land of five rivers). Of the

* The scene of Dr. Sven Hedin's latest explorations (1908).

five important streams, the *Chenab*, *the Jhelum*, and the *Sutlej* are the most important. *Sind* is the province of the lower plain.

Kashmir, Chitral and the North-West Frontier Province afford striking contrasts to Punjab and Sind, just as Abyssinia offers many contrasts to the plains of Egypt. *Baluchistan* is, to all intents and purposes, a British protectorate; it is an upland salt-basin with a mountainous border. *Afghanistan*, even more mountainous, touches our north-western frontier.

Climatic Conditions and Agriculture.—The climate of the *Indus Basin* is more *extreme* in type than any other region in India. The summers are exceptionally hot, especially before the monsoons bring rain. Winters are about as cold as in the *Ganges Basin*. Of course the uplands of the north-west are colder still. *Sind* has an average winter temperature of 64° F.; *Chitral* is 14° colder. Both sections of the Indo-Gangetic Plain exceed 90° F. as an average summer temperature. Range is therefore considerable, reaching 40° F. for Sind. This is exceptionally high for a region so near the tropics. The *low rainfall* serves to explain the high range of temperature; Sind receives on the average only 10 ins. a year.

So warm and dry a basin is favourable to the cultivation of *cereals*; *wheat* is a staple export from the Punjab *viâ* Karachi. The mountain provinces yield *timber* from the hill-slopes; pines, oaks and birches are among the most useful trees; *wool* and *goats' hair* come from the farms in the grassy upland valleys and the steppe-lands of the plateau.

Minerals are of inferior importance. *Coal*, *salt*, and a little *gold* are mined in the mountainous north-west. The salt range is, first and foremost, famous for its mammalian fossil remains of Tertiary age.

Towns and Communications.—Towns are of three types in the Indus basin. They are either political capitals, agricultural centres or strategic stations on the frontier. Very often one and the same town serves more than one of these purposes.

Karachi is the gateway of the basin and its only port; it stands well away from the delta, towards the frontier (*cf.* position of Marseilles on Rhône delta). It has important shipping trade, and is the base of railway communication with the basin. Cargoes of all the produce of the interior may be seen at its quays. *Haiderabad* is the political capital and the agricultural centre of the province of Sind. It is well placed for railway and river traffic. From it two trunk lines follow opposite fringes of the Thar desert to the Punjab and the Ganges basins respectively. *Multan* is the principal town of the Lower Punjab region. *Lahore* and *Amritsar* stand near together (forty miles), on the higher part of the Punjab plain.

Away among the woods and farms of the *Kashmir* section of the Himalayas, in the upper valley of the Jhelum, is *Srinagar*, the political centre of the Kashmir province.

It has no railway communication with the cities of the plain. A small branch from *Lahore* has penetrated the province by way of the valley of the *Chenab*.

The hill-station of *Simla*, used as the head-quarters of the Viceroy and his suite during the unhealthy summer of the plains, stands near the *Sutlej*, but not very far from the sources of the Ganges. It has railway communication with both sections of the Indo-Gangetic plain. The command of the passes in the ranges on the North-West Frontier grows more important every year. *Russia* has pushed her way through *Turkestan* until now only a narrow tongue of Afghanistan divides her frontier from the British provinces of Chitral and Cashmir. *Gilgit*, in the latter province, and *Chitral* have therefore great strategic importance as com-

manding the entrances to the plains of India from this quarter.

The two important cities of Afghanistan are *Kabul* and *Candahar*. Each is favourably placed opposite the gaps in the hill-frontier. Indeed, the stream on which Kabul, the more important of the two cities, stands is a tributary of the Indus, and its rocky defile (*Khaiber Pass*) affords ready access to the basin. *Peshawar* is built on the same river, and has

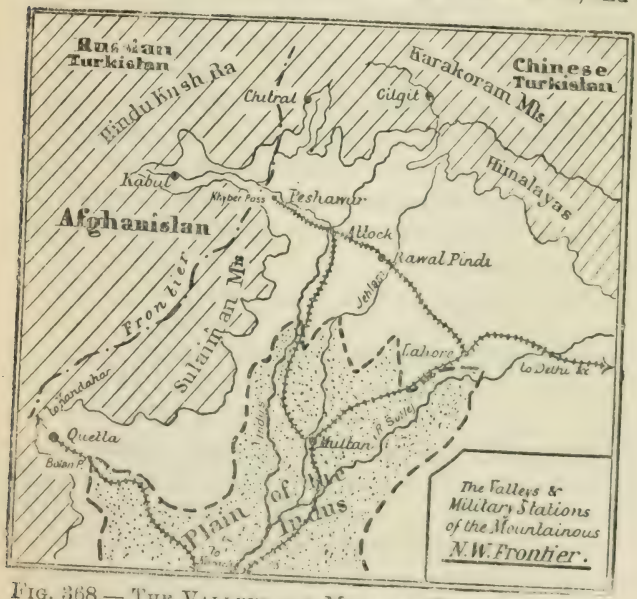


FIG. 368.— THE VALLEYS AND MILITARY STATIONS OF THE MOUNTAINOUS N.-W. FRONTIER.

been constituted the capital of the newer-formed (1901) North-West Province.

Quetta, acquired from Baluchistan, serves to check aggression from Kandahar. It stands on the *Bolan Pass*, at the head of the *Kurram Valley*, which penetrates back upon the Baluchistan tableland, and divides the *Hala Mountains*

of the south from the *Suliman range* to the north. It is connected with the Indus valley railway system by the Sind-Pishin Railway and a line through the pass.

Kashmir and Chitral remain protected states. Punjab, the old kingdom of the Sikhs; Sind and the recently-formed North-West Province are members of the Indian Empire; so also is the tableland of Baluchistan.

The barren *desert of Thar* forms a broad dividing belt between the Indus valley and the Ganges basin. It abuts against the *Aravalli Hills* on the east. This low range of ancient mountains is set in a S.W. to N.E. direction, *i.e.*, in the direction of the S.W. monsoon rain-wind. Both from its insignificant height and its general trend, the range fails to tap the monsoon as it blows over towards the Himalayas. The outer fringe is *steppe-like;* the interior is *sand-waste.* The railways mentioned in the last section follow the steppes on the west and the east.

(*b*) **THE GANGES VALLEY.**—If we carry the axis of the Aravalli Hills northward to the Himalayas, we mark the low "*divide*" which separates the waters of the Ganges system from those of the Indus. The Ganges valley is a broad trough between the *Himalayan range* and the northern edge of the *Dekkan crust-block.* We noted the changes of drainage set up on the northern section of the Dekkan. Two streams find their way, as we saw, to the *Arabian Sea*; two others flow in a north-easterly direction to join the axial stream of the trough—the Ganges. Of these latter, the *Chambal* gathers by many streams the waters of the dry uplands between the *crystalline* Aravalli range and the *volcanic* Vindhya ridge. The other river, the *Son*, drains the grassy lands of the coalfield.

Innumerable streams join the Ganges from the Himalayan ranges. The *Jumna*, which picks up the waters of the

Chambal, is the most important, and at its confluence with the Ganges is quite as important a river. The short river *Gumti* and the longer river *Gogra* join the Ganges at points between the confluence of the Jumna and the Son. That great river, the *Brahmaputra*, can scarcely be called a tributary. It uses the same delta, to which it contributes some share of silt.

The principal difference between the basin of the Ganges and that of the Indus is the *difference in rainfall* experienced. The *Himalayas* (150 to 400 miles in breadth; 1,500 miles long) are of great height. As a result, they form an *effective rain-barrier*. The effect is more marked as we move toward the east. The *Khasia Hills* and *Upper Bengal* are the rainiest regions outside the tropics. The rain falls mostly in summer and autumn. The great heat and excessive rain make the summer climate of the plains most unhealthy. But the Ganges basin is the most productive of all the regions of India. *Tea* on the slopes, *cotton*, *sugar*, *rice*, *indigo* and *opium* on the plains, are cultivated with ease. *Wheat* in the upper and drier region, and *jute* on the lowlands around the delta, are grown for export. The steppes of the Chambal basin and the Son River valley export *wool*.

Towns and Communications.—*Calcutta*, the metropolis of Bengal, is the gateway of the basin. Like *Karachi*, it is the export outlet, and has an important shipping trade. It stands on one of the distributaries well within the delta. This stream, the *Hugli*, is kept open by constant dredging. Below Calcutta its course is through thick, unhealthy jungle. The city of Calcutta is as large as Liverpool. From it railways diverge to all the great cities of the Empire. Trunk-lines follow the valleys of the Ganges and the Jumna till they link on to the railways of the Punjab and the Indus basin. Calcutta is also the great emporium for the Indian wares in wool, wood and metal, which have a world-wide fame.

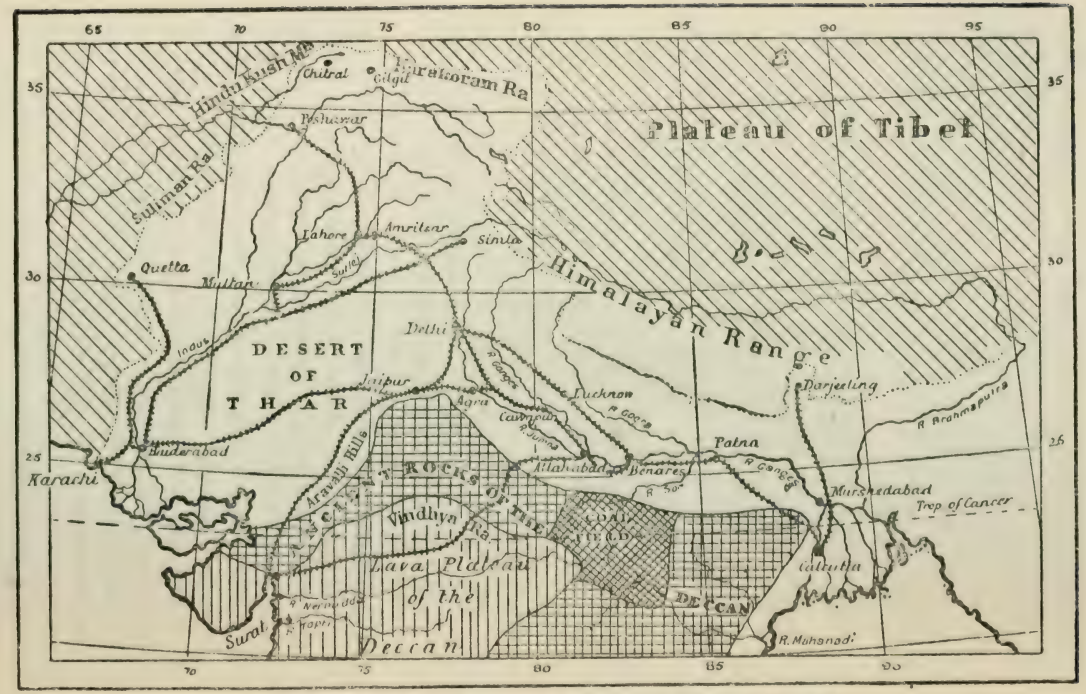


FIG. 369.—THE BASINS OF THE INDUS AND THE GANGES.

Following the Hugli, or taking the train, we gain *Murshidabad*, at the head of the delta, after passing the battlefield of *Plassey* on the way. The line proceeds due north to the hill-station of *Darjeeling*, under the shadow of Kanchinjinga (28,150 feet), next highest peak to Everest (29,000 feet), the culminating point of the range. The valley railway strikes from Calcutta to *Patna* at the confluence of many streams. The town is a market centre for the lower half of the valley. It is about as large as Sunderland or Cardiff. Thence the railway hugs the river as far as *Benares*, the "holy city" of the Brahmins. A religious centre, it is also an important market for Indian ware. It has a population equal to that of Newcastle.

Allahabad stands at the next confluence—the meeting place of the twin streams, the Ganges and the Jumna; its commercial interests are agricultural. It is rather bigger than Patna.

Cawnpur and *Lucknow* are some fifty miles apart, the former on the Ganges and the latter on the Gumti. Both have connection with stirring events in the Indian Mutiny (1857).

Agra, on the Jumna, boasts its famous Taj-Mahal, the tomb of the favourite wife of Shah Jehan, a Mogul emperor, built in the seventeenth century at a cost of about £3,000,000.

Delhi, once the ancient capital of the Moguls, is now by royal proclamation (1911) the political capital of India; it also stands on the Jumna. Here "East and West" meet. The town is an important railway centre and a centre of exchange. *Meerut* is the military town at which the Indian Mutiny first broke out.

The course of the Brahmaputra is much more varied than that of the Ganges. As yet, no railway has penetrated the upper valley.

In its upper course, where it is known as the *Sanpu*, it follows a trough in the Himalaya folded ranges. This region is outside British territory. On a tributary and near the

main river stands *Lhasa*, the sacred city of the Thibetans, who own allegiance to *China*. In longitude 95° E. the river bends back upon itself, and, traversing the valley of

FIG. 370.—THE GREAT BEND OF THE SANPU.

Assam with the *Khasi uplands* on the south, it reaches the plain of *Bengal* and turns due south to the Ganges delta.

Shillong, the tea-growing centre on the Khasi slopes of Assam is many miles from the river.

Dacca is a port on the delta.

The basins of the Chambal and Son are occupied by *native states*, under British protection. The grassy basin of the Chambal has few towns. *Gwalior* stands at the outlet. Its rock-citadel is world-famous. The provinces of the great basin are integral parts of the Indian Empire (Agra and Oudh, Bengal, Assam).

(*c*) **THE DEKKAN, SOUTH INDIA AND CEYLON.**—The ancient crystalline plateau of South India has for its highest rim the *Western Ghats*. The plateau drops suddenly to the *Malabar coast*, leaving little room for a coastal plain. The long slope of the plateau is towards the *Bay of Bengal* and the *Coromandel coast*. Here a broad belt of alluvial shoreland forms the coastal plain. The plateau has long been

exposed to sub-aerial denudation, and an intricate system of rivers has developed. Many streams converging form an *upper basin*, out of which the main stream descends by a *deep-cut valley* to the lowland plain. The *Mahanadi*, the *Godaveri*, the *Kistna* and the *Cauvery* are the principal streams. Each stream has built up a considerable delta.

The *Nerbudda* and the *Tapti* have scored deep, narrow valleys in the *basaltic plateau* at the north-western corner of the Dekkan. The upper streams of the *Godaveri* and *Kistna* are on the volcanic tableland also.

Climate and Productions.—The Western Ghats are sufficiently high to form a partial rain-barrier to the South-West Monsoon. The Malabar coast is the rainiest region. The long slope of the plateau is dry, especially in the interior. The Coromandel coast is fairly wet, owing to receiving rains from *both* monsoons.

The North-East Monsoon, blowing across the Bay of Bengal, picks up moisture and deposits rain on the *Nilgiris* and the hilly country of *Ceylon*.

Forests cover the rainy slope of the Ghats and the Nilgiris; *teak* is the most valuable timber; *cinchona bark* is exported. *Rice* and *cotton* thrive on the Malabar shore-lands.

The upper basins of the Dekkan streams, already referred to, are warm and dry; they are within the tropics and in the rain-shadow of the Ghats. *Wheat*, *wool* and *hides* are the products of these pastoral regions.

The basin of the *Mahanadi* most resembles that of the Ganges in climatic type and agricultural products; *wheat*, *cotton*, *oil-seeds* and *rice* are grown, and *teak* forests are plentiful. *Cotton* also thrives on the volcanic plateau. The hillier regions south of the Kistna specialise in *coffee* and *tea*; *indigo* is not so profitable; *teak* is a valuable product. *Rice*, *cotton* and *sugar* are the natural crops of the Coromandel and Carnatic coastal belt.

FIG. 371.—GEOLOGY OF THE PENINSULA OF SOUTHERN INDIA.

Minerals.—The Dekkan has from time immemorial been famed for its *precious stones*; the principal centre is the block of tableland (Golconda) south of the Kistna. Gold also occurs in workable quantities. In addition to the *Son River coalfield*, which is really on the Dekkan plateau, though it drains to the Ganges, we have a valuable coalfield in the lower valley of the *Godaveri*. The coal is of early Secondary Age, like all the coal-deposits of the once-existent continent of *Gondwana Land*, whose site was coincident with that of *Brazil*, the *Southern Atlantic*, *Central and South Africa*, the *Indian Ocean* and *Australia*.

Towns and Communications.—*Bombay* is most favourably placed opposite the *Aden gate* of the Red Sea. Moreover, it has better advantages for shipping than any other port in India. The town stands on the landward side of a small *island* divided from the mainland by a sheltered roadstead (*cf.* Zanzibar). From Bombay railways radiate:—

(*a*) To Sind, through the cotton plantations around the shallow Cambay Gulf, the still shallower Rann of Cutch;

(*b*) Along the foot of the Aravalli Hills to Agra and Delhi;

(*c*) Across the Dekkan, forking *viâ* the coalfields to Allahabad and Calcutta respectively.

(*d*) Over the Kistna basin to Madras.

Bombay taps the resources of the volcanic tableland and the forests of the Mahanadi upland basin. It not only exports cotton, but manufactures cotton goods, the staple clothing of the country.

Surat, at the mouth of the Tapti, was the first (1613) British trading-station on this coast.

Baroda, in the cotton-growing district of Cambay, was originally a Portuguese settlement. Bombay itself was first a Portuguese possession, passing to Great Britain, in 1662, as part of the dowry of Princess Catharine of Braganza.

Daman, a port midway between, remains Portuguese.

Goa is the most important Portuguese possession on the Malabar coast; here the coast strip is fairly wide, and very productive; the French have *Mahé*, just north of *Calicut*, at the Malabar foot of the Nilgiris. Calicut gives its name to calico.

Goa has direct railway communication with both Bombay and Madras; *Calicut* with Madras only, by way of the gap between the *Nilgiris* and the *Cardaimon Hills*.

Poona is the principal town on the Western Ghats. It is the summer headquarters of the Bombay Presidency. The town has a population equal to that of Cardiff.

Baroda, *Surat* and *Nagpur* have each above 100,000 inhabitants. *Nagpur* stands on the Bombay-Calcutta railway route, within access of the Godaveri coalfield. It has railway works and several manufactures.

Haiderabad is the capital of the largest of the native states, the Nizam's dominions, with a population of 11,000,000. The capital itself is nearly as large as Leeds. Near are the famous mines of *Golconda*.

Bangalore, in Mysore State, is the seat of the British residency; the smaller town of *Mysore* is the capital of the State.

Seringapatam, close to Mysore city, on the Cauvery, witnessed the defeat of the warlike Tippoo Sahib, in 1799, at the hands of Eyre Coote.

Many towns have established themselves along the fertile coast-belt, from the *Mahanadi delta* to the *Palk Strait*, whose waters hide the submarine ridge which links Ceylon to the mainland.

Cuttack is the outlet of the Mahanadi basin, though the upper valley is crossed by the Bombay-to-Calcutta railway.

Masulipatam serves both the Godaveri and the Kistna valleys.

Madras is the most important city of Southern India. It ranks next to Calcutta and Bombay, though little more than half the size of either. It is the capital of the Madras Presidency, which practically coincides with the coastal belt from the Mahanadi to Cape Comorin. (Cuttack is in the Province of Bengal.) It is at a great disadvantage for lack of harbour accommodation.

Negapatam is the port of *Trichinopoli*, a busy manufacturing centre in the Cauvery valley.

Between Madras and Negapatam occur the French stations of *Pondicherri* and *Karikal*.

Other French stations on this coast are *Yanaon* on the Godaveri delta, and *Chandarnagar*, just above Calcutta.

A railway traverses the coastal plain, linking up all towns and ports from Calcutta to Negapatam and Calicut.

CEYLON is a mountainous *outlier* of the Peninsula of South India. It reproduces the physical features of the *Nilgiris* and the *Cardamon Hills*. The culminating peaks attain an average height of 6000 to 7000 feet.

Piduratalagalla, in the south of Ceylon, reaches 8320 feet. Adam's Peak is well seen by sailors approaching Colombo.

The north of the island is low, and corresponds to the Coromandel coastal-plain. Ceylon recives rain from both monsoons; its temperature is tropic; the average latitude of the island is 7° N. *Coffee*, *tea* and *cocoa* are the prime exports; *coco-nuts*, *spices* and *rice* are cultivated. The warm, shallow waters of *Palk Strait* are the scene of *pearl fisheries*. *Adam's Bridge* is a reef on the submarine connecting platform between the island and the mainland.

Kandy, the ancient capital of the island, stands away up in the heart of the country. It is connected by rail with Colombo.

Colombo, advantageously placed on the eastern trade-routes, is the base of trade; mail boats call. *Galle*, in

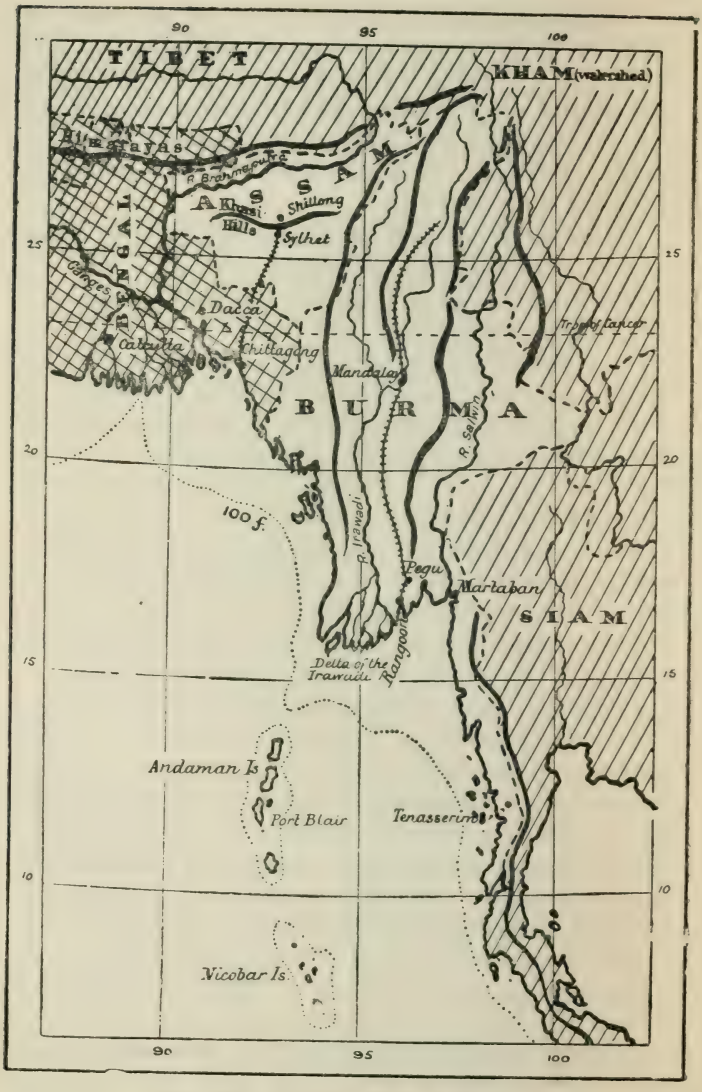


FIG. 372.—OUTLINE MAP OF BURMA.

the south, and *Trincomali*, in the north, are smaller ports. The latter is a naval base.

Ceylon is not included in the government of India; it is a *crown colony*, with a council in addition to a governor.

(*d*) **BURMA.**—The province of Burma has many physical peculiarities which mark it off from India, to which it belongs politically. It is a mountainous country, built up of parallel *folded ranges*, with *intermont valleys*. Rainfall on these mountains is excessively heavy. Swollen streams emerge from the valleys, and build up deltaic land. A strip of lowland is formed, and this is very fertile. The trend of the ranges and valleys is almost due north and south. The rivers resemble those of British Columbia and other parallel-folded mountain regions in their zig-zag character.

The *Irawadi* is the premier stream. It rises on the *Kham* watershed, in Chinese territory; it has few tributaries; its delta resembles those of the Ganges and the Mahanadi in its fan-structure.

The parallel *Salwen River* empties into the *Gulf of Martaban;* for fifty miles it serves as a political frontier.

The *Andaman* and *Nicobar Groups* form an island-chain, which is the partially-submerged continuation of the *Arakum Yoma Mountains*, the most westerly range in Burma.

Burma differs widely from Bengal in physical structure, but resembles it in its *excessive rainfall.* Summer and autumn rains, brought by the S.-W. Monsoon, predominate.

Productions.—*Teak* forests are characteristic of the mountain slopes. *Cotton, rice* and *sugar* thrive in the valleys and on the deltas.

Gold and *rubies* are obtainable in the uplands, but the principal wealth of these ranges is in their *tin* deposits. *Petroleum* is plentiful in the valley sandstones below Mandalay.

Towns and Communications.—*Rangoon* is the port of the province; it stands on the Martaban side of the *Irawadi delta*; its quays are busy with the export of *teak*, *tin*, and *petroleum*. A railway now serves the Irawadi valley from Rangoon to the sources of the river. *Mandalay*, the capital of the country, stands on the Irawadi at the point of intersection of this railway with the river. The two towns each number about 180,000 inhabitants; all other ports and trading centres are small. Among these, *Bhamo* on the Upper Irawadi, *Bassein* on the delta, *Pegu* near Rangoon, deserve notice. *Martaban* and *Maulmain* are placed on opposite shores of the *Salwin* mouth.

The *Lushai Hills* divide Burma from Assam and Bengal. The valley between them and the Khasi Hills is a famous tea-growing region. *Sylhet* is the plantation centre. A railway connects it with *Chittagong*, on the Bay of Bengal.

The province of *Tenasserim* belongs, politically, to Burma. It forms the western flank of the Malay peninsula as far south as the Isthmus of Kra. *Tin*, *teak*, and *cotton* are its available exports.

CHAPTER V.

The Chinese Empire.

THE Empire of China is naturally divided into *three major divisions* :—

1. The *lowlands* of the northern sea-board.
2. The *parallel ranges* of the south.
3. The *tablelands* of the interior.

Each of these regions is again divisible into its geographical units as follows :—

1. (*a*) Basin of *Manchuria*.
   (*b*) The plain of the *Hoang-ho*.
2. (*a*) The valley of the *Yang-tse-kiang*.
   (*b*) The valley of the *Si-kiang*.
3. (*a*) The highlands of *Mongolia*.
   (*b*) The basins of *Tarim* and *Gobi*.
   (*c*) The lofty plateau of *Tibet*.

Manchuria belongs almost entirely to the basin of the *Sungari*, and drains northward to the great River *Amur* which forms its frontier. A stretch of Russian territory shuts it out from the Sea of Japan, though only a coast range intervenes between it and the harbour of *Vladivostok*. Manchuria gave China her present dynasty. Of late years the province has come much under Russian influence; it is traversed by a branch of the *Trans-Continental Railway*, which is here operated by the *Chinese Eastern Railway Co.*, in which Russia is the predominant partner. The railway forks at *Harbin*, or Kharbin, in the two branches to *Vladivostok* and *Port Arthur* respectively. Kharbin is on a navigable river, and must, soon or later, become a place

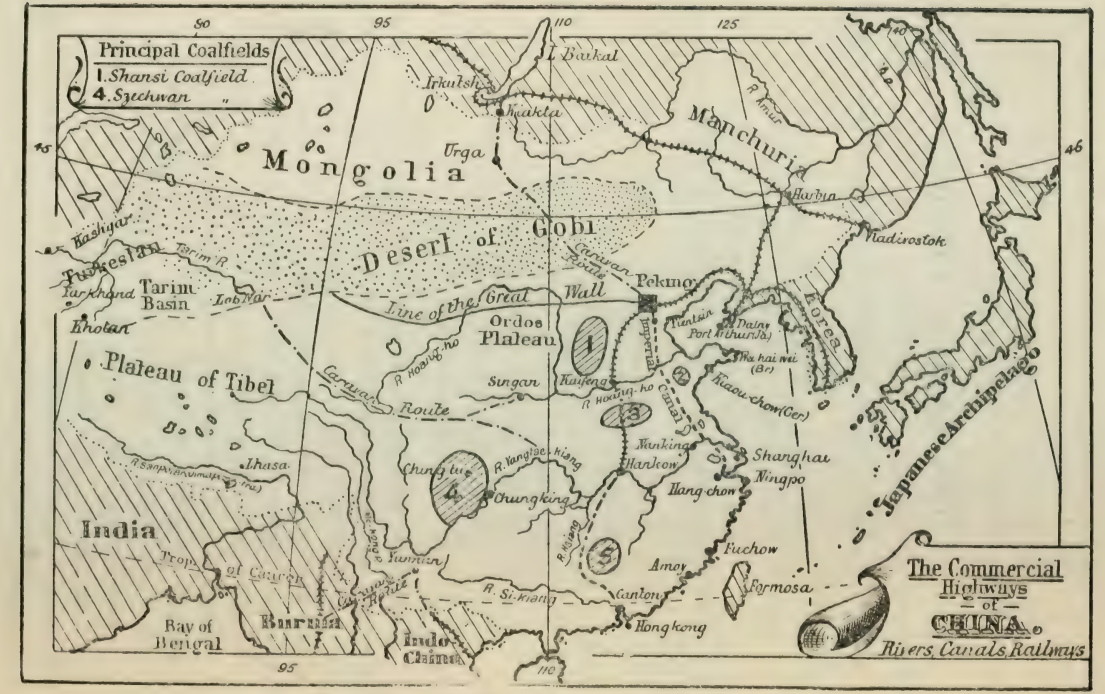


FIG. 373.—THE COMMERCIAL HIGHWAYS OF CHINA.

of considerable importance. *Lumbering* and agriculture find occupation for the inhabitants of the province.

Newchwang is the free port of Manchuria, and has railway communication with Pekin.

NORTHERN CHINA.

The old kingdom of China may be taken to correspond roughly with the basin of the *Hoang-ho*. This river rises away back on the northern edge of the plateau of *Tibet*, in the *Kuen Lun Range*. It flows round the base of the *Ordos Plateau*, and then skirts the southern edge of the *Shansi* tableland, eventually emerging on the plain of China. Rising from this plain, and projecting into the Yellow Sea, is the ancient block of the *Shantung Peninsula*. The plains of the Hoang-ho have always been liable to severe **floods**, and the course of the river has changed many times. Its outlet was formerly to the south of the Shantung peninsula. The river now empties itself on the northern side of the peninsula into the *Gulf of Pe-chi-li*. **Irrigation works** and **dykes** have done something to minimise the dangers from flood, but dangers still exist. The river becomes important only after breaking through the mountain rim east of the Ordos plateau. Rapid development of the **coal** and **iron** resources must come sooner or later. The principal town of the region is *Taiyuen*. *Kai-ping* is an important coal-mining centre. *Singan*, at the foot of the dividing range and the plateau rim, is one of the largest towns in China. It numbers nearly 1,000,000 inhabitants. **Tobacco** is grown in the neighbourhood. *Kaifeng* promises to become one of the principal cities on the plain, for it stands on the Hoang-ho, where it crosses by the Pei-han Railway (the most important line in China, from Pekin to Hankow. *Pekin*, the capital of China, stands on a small stream to the north of the Hoang-ho; *Tientsin* is the port of the capital. Together their population reaches

the enormous total of one and a half millions. In addition to the Pei-han Railway, running southward across the Chinese plains, *behind* the flood region, a northward extension has been made, linking the capital with the *Port Arthur* branch of the Trans-Siberian Railway at *Newchwang*, the principal port of Manchuria. *Tientsin* is also the northern terminus of the *Imperial Canal*, which crosses the coast-belt to Hangchow.

MID-CHINA.

The Yang-tse-kiang, the fourth river in the world, finds its source in the Tibetan plateau, on the southern side of the Kuen Lun axis. In its upper course it receives its tributaries mainly from the forested rim of the central plateau. In its lower courses it receives innumerable streams from the parallel valleys of southern China. *Mining developments* are probable in the upper regions of the head streams of this river. *Tin-ores* and *copper deposits* are available. The province of **Szechwan** is exceptionally rich in *coal*. The *lake-basins* in Mid-China afford exceptional possibilities in *agriculture*.

Yunnan is the great trading-centre in the upper valley of the Yang-tse. It stands on the *watershed* within easy access of the Irawadi and the other rivers of Indo-China, and near the source of the *Si-kiang*. It has for centuries served as a trading depôt between *Burma*, *Indo-China*, and *China* proper. The **French** have pushed their railway beyond their own frontier to *Yunnan*. **Great Britain** has carried the Burmese railway beyond *Bhamo* (which is connected to Yunnan by a well-worn caravan route) to the edge of the *forest* and *mining regions* of the upper streams of the Yang-tse-kiang. The region around Yunnan is famous for its fields of the *opium-poppy*. Yunnan is the focus of traffic in *opium* with India.

Chengtu is the centre of activity in the rich "**Red Basin**" of Szechwan.

Chunking is the river port of the province. *Hankow* stands at the outlet of the principal inland basin of the Yang-tse; on it many streams converge. It is the centre of the *silk* and *cotton* industries of the basin. Three towns coalesce at this point—*Hankow*, *Wuchang*, and *Hanyang*. The railway from Pekin, which crosses the Hoang-ho at *Haifeng*, terminates on the Yang-tse at Hankow. It will be carried eventually across the lake basin by way of the north-south valley of the Hsiang to the *Si-kiang*, to *Canton* and to *Hong Kong*, the busy emporium of the south. Below Hankow the river winds over the lake-plains and opens out on the coastal-plain of *Nanking*.

Nanking is a busy centre of the *cotton*, *silk* and *soap* industries. Many lakes occur on the coastal-plain. The ports which serve as outlets of the basin stand away from the silted mouth of the river. **Shanghai** is the most important. *Hang-chow* and *Ningpo* are additional ports for the outlet for the silk and cotton of the thickly-populated coastal plain. Nanking is half the size of Shanghai.

SOUTHERN CHINA.

As the transverse range of the *Pe-ling Mountains* divides the Hoang-ho from the basin of the Yang-tse-kiang, so the east-west range of the *Nan-ling Mountains* shuts off the parallel valleys which drain to the Yang-tse from the southern basin of China, the valley of the *Si-kiang*. This basin is *the principal tea-growing region*, the coastal plain is the region of *sugar* plantations. We have already noted the very important trading centre of Yunnan on the "divide" at the source of this river. No other important city occurs until we reach the flood plains opening out to the estuary. *Wuchang*, on the *Tropic of Cancer*, is the first important town. *Canton* is the

great outlet; it is, however, second in importance to **Hong Kong** (our British *entrepôt* in the east), but its population reaches 900,000.

Several important ports occur on the coastal plain between Shanghai and Canton. *Ningpo* has been mentioned in connection with the Yang-tse outlets. *Fuchow* and *Amoy*, opposite the Japanese island of **Formosa**, are the principal outlets for the tea and sugar of the coastal plain. *Fuchow* has three times the population of Amoy. It is nearly as large as Shanghai.

All the sea-ports mentioned in this section, in addition to the river ports of the Yang-tse and Si-Kiang, are "**treaty ports**," *i.e.*, they are open to foreign trade. The principal European Powers have, as we have already seen, secured bases on the promontories which separate the Gulf of Pe-chi-li from the outer Yellow Sea.

At the mouth of the Canton River the Portuguese have held *Macao* since 1586.

Hong Kong is a rock island on the north side of the Si-kiang estuary, built of granite. It is the **principal distributing and shipping centre for Southern China,** and corresponds in importance to **Shanghai,** the outlet of mid-China, and Tientsin, the port of the northern capital. At the *change of the monsoons* the waters of the South China Sea are liable to sudden cyclonic storms which are called *typhoons*. They have often brought disaster to the shipping in the harbour of Hong Kong. A strip of country (*Kow-Loon*) on the mainland opposite Hong Kong is also in the possession of Great Britain.

THE CHINESE INTERIOR.

Tibet.—The rims of the plateau of Tibet are very definitely marked on the north, south and west. To the east the tableland drops quickly to the valleys and gives rise to the *gorges* of the head-streams of the Yang-tse. The lofty *Himalayas* form the southern rim and an effective *rain-barrier*. The

broken rim on the east is almost as effective. The *Hindu Kush* and the *Pamirs* form a strong natural frontier on the west.

Several lofty ranges traverse the plateau, which itself has an *average altitude* of 12,000 feet above sea level. They serve to divide the plateau into distinct basins. The long valley which drains in two directions, by the *Indus* and *Bramaputra*, is cut off by the *Marco Polo Range* from the basin of *Koko Nor*. **Lhassa**, the famous city of Tibet, stands on the north side of the *Bramaputra* valley.

The Desert Belt.—North of the Karakoram Range and the Kuen Lun Mountains we encounter a desert-belt at a much lower level than the tableland of Tibet. In the west it corresponds with the Tarim Basin (**Chinese Turkestan**). The northern boundary of this basin is the lofty *Tian Shan Range*, at the foot of which the Tarim River flows. The course of the river is comparatively fertile, but the rest of the basin is arid sand-waste. The river terminates in the swamps of *Lob Nor*. Only along the course of the stream, or on the flanks of the boundary ranges, can the population subsist. *Sheep* and *goats* provide the materials of clothing; the *Yak* is the beast of burden. *Kashgar* in the extreme west, at the foot of the Pamirs, is the principal caravan centre. *Yarkand* and *Khotan* are in subsidiary valleys to the south. The eastern belt of desert belongs to *Mongolia*, and descends to the northern bank of the Hoang-ho. Even the Plateau of *Ordos* itself is capped by sand-wastes. The *Khingan Mountains* form the eastern boundary of the desert and of the province.

The *Altai Ranges* separate **Mongolia** from the steppe-lands of Russia-in-Asia. Northern Mongolia is filled with mountain ranges, the valleys of which drain out to the Siberian rivers.

The slopes of these ranges are forested, and yield excellent supplies of **timber** (*pine*, *spruce*, *fir* and *larch*). They are also rich in **metallic ores** (*gold*, *silver*, *copper*, *iron*), like the highlands around Lake Baikal.

Urga is the principal caravan-centre on the north of the *Desert of Gobi.* It stands near the source of the river, which drains to *Lake Baikal.*

In the lower valley of this river occurs the trading centre of *Kiakhta*, already mentioned in connection with the traffic in "brick tea" between China and Russia.

THE JAPANESE EMPIRE.

The Empire of Japan includes the *Japanese Archipelago*, the mountainous peninsula of *Korea*, and the rocky island of *Formosa.* The southern half of the island of *Saghalin* is also included in the Empire. Every part of the Japanese Empire is mountainous, and insular or peninsular in character. The student will therefore expect differences in climate from the conditions prevailing in China. Apart from Formosa, the Empire lies north of latitude 30°, *i.e.*, north of the basin of the Yang-tse-kiang. The warmer parts of the archipelago and the peninsula of Korea correspond in latitude to the basin of the Hoang-ho. The colder parts of the archipelago and the island of Saghalin are in the latitude of the Amur basin. A *great variety of climatic type* will therefore be expected. **Formosa** is on the *Tropic of Cancer.* Japanese **Saghalin** stretches 70° N. of Vladivostok, and has a *sub-arctic* climate, although its latitude is only that of the Paris Basin. We noted in our study of China the parallel ranges of Southern China trending in a S.W.-N.E. direction. The mountains of **Korea** have a similar trend. Their axes do not follow the projection of the peninsula but strike across it transversely, giving rise to parallel valleys and streams. The mountains of Korea have many affinities with those of the *Shantung* peninsula, on the opposite shore of the Yellow Sea. The islands of the *Japanese Archipelago* form the northern half of a long chain, extending from the peninsula of *Kamschatka* through the *Philippines*, the *Celebes* and the

East Indian Archipelago to the *Andaman* and *Nikobar* chains in the Bay of Bengal. This long line of islands is **the most remarkable seismic line in the Old World.** It is studded with *volcanoes* throughout its length. Many of these are still active, and *earthquake shocks* are common. Several of the volcanoes attain a height of 15,000 feet. *Fusi-yama*, one of these, in *Hondo*, is the sacred mountain of the Japanese.

In *Kamschatka* the volcanoes are on the outward flank of the mountain axis; in the Japanese group, they are mostly on the inner flank. The strips of *coastal plain*, which are very narrow both in Korea and the Japanese islands, are covered with Tertiary deposits (*cf.* Thames Basin). The mountain axes are built up of ancient rocks. Just outside the Japanese island-chain the *Pacific* drops to a depth of 27,000 feet (in the **Tuscarora Deep**). Within the island-chain the seas are comparatively *shallow.* The "*seismic line*" therefore corresponds with the true border of the continent.

Hondo is the main island. Its latitudes are those of the *Mediterranean Sea* and *California.* Separated from Hondo by narrow channels (sea-filled rift-lines) are the islands of *Kiuchiu* and *Shikuku* in the warmer south and *Yezo* in the colder north. The long chain of the *Kurile Islands* links Yezo with the Kamskatchan peninsula. The islands belong to Japan, the peninsula is Russian territory. A similar chain of volcanic islands links Kiuchiu with Formosa. The islands of the Empire thus enclose three seas: the *Yellow Sea*, the *Sea of Japan*, and the *Sea of Okhotsk.* The Yellow Sea is always open, the Sea of Japan is liable to ice in the depth of winter, and the Sea of Okhotsk is sub-Arctic in character, although its latitude is only that of the British Seas.

Climatic Conditions.—Formosa, Korea, and Hondo (and the smaller islands to the south) belong to the **Monsoon Region.** They receive their heavy rains from the *South Monsoon*, which corresponds in time (summer) to the South-west Monsoon of

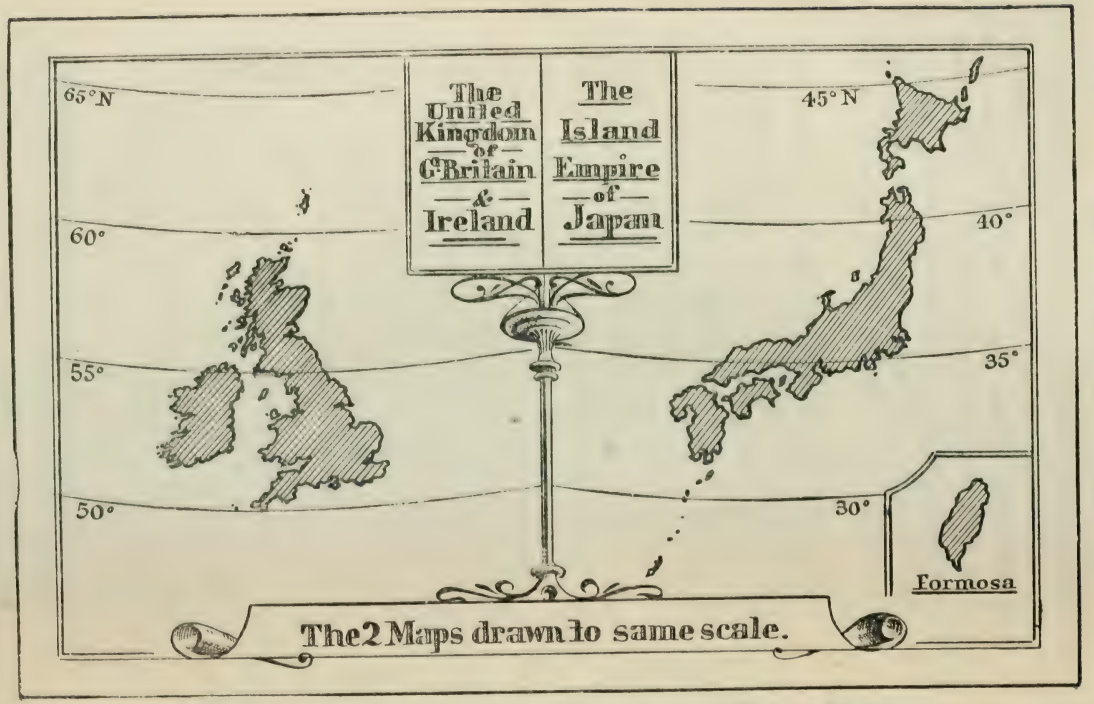


FIG. 374.—COMPARISON BETWEEN JAPAN AND THE UNITED KINGDOM.

the Indian Ocean. The *North Monsoon* (winter) brings some rain to *Formosa* after blowing across the Yellow Sea; it brings still more to *Japan*, after blowing across the Sea of Japan, the reason being that the mountain axis of Hondo is placed more normally to the wind (*see* Part I. Chap. V.). The inner shore of Hondo therefore receives considerable winter rains. *Saghalin* and *Yezo* form the driest part of the Japanese Empire.

At **Formosa**, on the Tropic of Cancer, *days vary very little in length throughout the year*, the longest day being about thirteen hours and the shortest about eleven hours. The island is open to the tempering influences of the ocean. The *range* of temperatures is therefore very *small* (20° F.). In the southern half of the Japanese archipelago the range is higher, averaging 35° F. This is partly due to the higher latitude, where summer days *vary more* from winter days in length. The range is not so considerable in Japan as in China (50° F.). The conditions of oceanic circulation and rainfall account for this. The **rainfall** is heavier in the south of Hondo and the off-lying islands than in China. These tend to make the climate more equable (*see* Part I. Chapter V.) The circulation of the **warm drift of the Pacific** is another factor influencing the climate of South Hondo, whilst it has little effect upon the compact Empire of China. The "*Kuro Siwo*," the warm current from the tropic regions, the "Gulf Stream" of the Pacific, laves the outer shores of *Formosa* and the *Japanese Archipelago*, and strikes across the Pacific Ocean in a north-east direction.

The **summer** climate of Hondo and Korea resembles that of *New York*. The temperatures are equal to those of the Mediterranean. **Winter** temperatures are again similar to those of the regions mentioned. *Tokio* is as cold as London at Christmas and as warm as Marseilles in July. It stands 15° lat. nearer the Equator than London does, and 8° lat. nearer than Marseilles. **The extremes** are therefore greater

FIG. 375.—SKETCH MAP OF THE JAPANESE EMPIRE.

in Japan than in the British Archipelago, although latitudes would suggest the opposite. The climate of Japan, like its relative position to the ocean on its border, is best compared with that of *Nova Scotia*.

We have seen that the whole of the possessions of Japan are mountainous in character. It is evident, therefore, that agriculture can never support dense populations like those of the plains of China and North India. Only on the *shore-lands* can agricultural development take place, and these have been utilised to the fullest extent. The largest area of lowland lies around and to the north of Tokio. *Rice* and *sugar* are the principal crops on the shore-lands. *Tea* is grown on the hilly plantations. *Silk* is an important product in the archipelago. The agricultural and industrial conditions are similar to those of the Yang-tse-kiang basin rather than to the plains of China.

The Empire is not without its mineral wealth. Some *gold* occurs. *Silver ores* are very important. *Coal* is raised in the island of Kiuchiu and in the northern islands of *Yezo* and *Saghalin*. Hondo has a small coalfield in the S.E.

The **Japanese Empire** numbers a population of sixty millions; rather more than one-tenth of these are engaged in *manufactures*. Agriculture still supports more than half of the population, from an industrial point of view. The district between *Tokio* and *Nagasaki* is the most important. *Kioto* and *Ozaka* form the focus of the manufacturing industries of the Empire. The former is the ancient capital, and is rich in Buddhist temples. *Osaka* has far outstripped it in population. The port of *Tokio* is *Yokohama*, the Gate of Japan, opening towards the Pacific Seas. The capital and its port number over two million inhabitants. *Nagasaki* promises to become the principal outlet towards China, and Japan's watchful eye upon her interests in the Yellow Sea. Railways link all the towns on the lowlands.

Beautiful **Formosa** has a small coalfield in the north, and the outlet port is *Kilung*. A railway joins it with *Tainan*, the principal port of the island, within easy access of Hong Kong and Amoy.

Korea is the most backward member of the Japanese Empire. *Rice* is the principal crop, and is grown on the shorelands. *Cotton* is a promising crop. *Hides* are a valuable export from the farms of the mountain valleys.

Fusan is the nearest point to Japan, the terminus of the *Korean Railway*, and the port for Japanese trade. *Seoul*, the capital of the peninsula, is a squalid town of 200,000 inhabitants. Its port is *Chemulpo*, which gains in importance by its position in the Yellow Sea. Its importance is not so great, however, now that Japan holds *Port Arthur*. Japanese protection (since 1905) is making for the development of Korea's resources and advance in its civilization. The peninsula had been under Chinese suzerainty for nearly a thousand years.

The student will notice the frequent recurrence of certain components in Chinese geographical names. He will be interested to know the meaning of some of the more common terms. Below we give a few of these :—

Hien (or *hsien*), a country.	*Chow*, a department.
Fu, a province.	*King*, a capital.
Pei, north.	*Si*, west.
Nan, south.	*Chung*, middle (central).
Tung, east.	
Ho, a river (N. Ch.).	*Pa*, plain.
Kiang, a river (S. Ch.).	*Kwang*, expanse.
Ling, a range.	*Hai*, sea.
Shan, mountains.	*Hoo*, lake.

GEOGRAPHY OF SOUTH AMERICA.

CHAPTER I.

World-Position, Dimensions, Broad Outlines of Physical Features and Geological Structure.

[Maps to be studied: Terrestrial Globe; Mercator's map of the World; Orographical map of South America; and a Geological map of South America.*]

World Position.—The continent of **South America** is often compared with the two other continents of the Southern Hemisphere—**Africa** and **Australia**; and, indeed, where the three continents occupy the same belts of latitude the similarities are very striking. **South America** has, however, no territory in the latitudes of the *Sahara Desert* and the *Lower Nile* region of North Africa. Its most northerly latitude (12°N.) is only that of *Lake Chad* and the *Abyssinian Highlands.*

Colombia, *Venezuela*, and the three *Guianas*, are in the same zone as *West Africa*, the *Sudan*, and *Aden.*

The longest line that can be drawn across South America is just about the same as that which can be drawn across

* Outline map given on page 821.

Africa; both continents stretch through about 45° of latitude (say, $45 \times 69 = 3{,}105$ miles); Africa's most northerly point, opposite *Sardinia*, is 25°N. of the *Caribbean shore* of South America; South America's most southerly point, *Cape Horn*, is 20° nearer the South Pole than *Cape Town*. The stony wastes of *Patagonia* lie farther south than any part of the African Continent or Australia.

The middle latitudes of South America are those of Australia; the *Tropic of Capricorn* crosses both continents in these middle latitudes.

The Basin of the *Amazon* finds its counterpart in that of the *Congo* of Central Africa.

The *Republics of the Plate River* occupy latitudes corresponding to those of our *South African Dominions* and our *Australian Commonwealth*.

Patagonia is in similar latitudes to *France*; only the wild region of *Tierra del Fuego*, and the islands of *Cape Horn*, are in latitudes at all corresponding to our *British Archipelago*.

On the whole, the Continent of South America lies more *east* than the North American land-mass. The most westerly longitude on the coast of *Ecuador* is that of *Florida* and *Lake Huron**; the most easterly point (*Cape Branco*) is only 35°W. of London and 17°W. of *Cape Verde* on the African seaboard; between these points the *Atlantic Ocean* is narrowest (about 1,600 miles). The student is warned, however, that Mercator's map is liable to mislead him and cannot be used for distances; a globe should be used. He will remember that the distance from Galway to Newfoundland is only some 1,700 miles.

Broad Outlines of Geographical Structure and Physical Features.—The most striking feature of the South American continent is *the long Cordillera of the Andes* which determines

**Lake Superior* and *Chicago* are farther west than any point on the South American mainland.

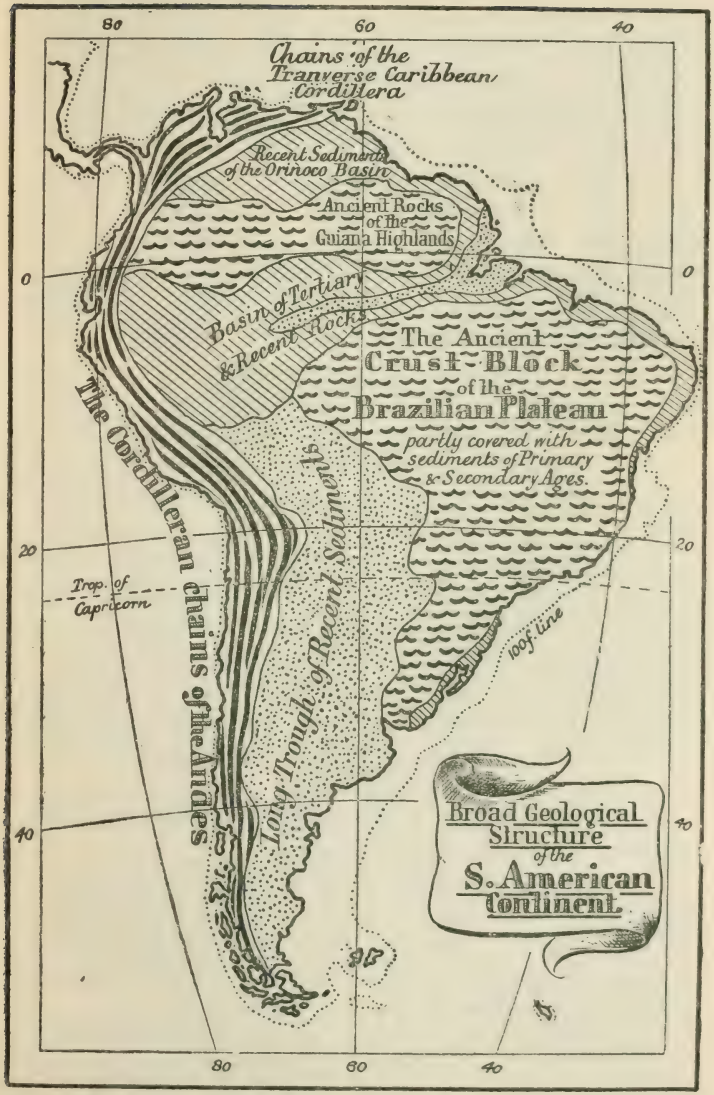


FIG. 376.—BROAD GEOLOGICAL STRUCTURE OF SOUTH AMERICAN CONTINENT.

the outline of the *Pacific seaboard*; the waters of the Pacific frequently touch the western foot of the cordillera. Only in its *middle region* does the cordillera expand into a *plateau* with an upland basin (**Bolivia**) recalling the broader plateau on the Rocky Mountain Cordillera of North America.

The **Andes** are a true continuation of the Rockies; together they make a mountain-axis nearly 9,000 miles in length. The Pacific flank in both countries is a "*seismic line*"—a region of *earthquake* disturbance and *volcanic* phenomena. These phenomena are characteristic of the process of mountain-making, a process which is not completed in the axis we are considering. The Andes are *a true mountain chain* consisting of strata of all geological ages involved in the folding and crumpling which accompany mountain-making. *Volcanoes* are exceedingly numerous along the Andean chain and are exceptionally fine examples of their class.

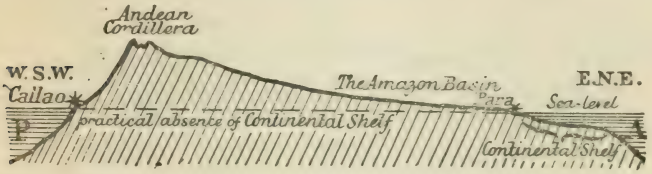
Africa has nothing to compare with the Cordillera of the Andes. The *Alps*, the *Caucasus*, the *Himalayas*, are other examples of lofty folded mountain ranges. The long wall of the *Australian Alps* stretching from Cape York to Tasmania is a feeble reproduction of the Andean Chain. It, too, lies along the Pacific seaboard. Indeed *the entire rim of this ocean* (in Asia, Australia and the two Americas) is the most remarkable "*seismic line*," in the world.

The **Eastern Section of the Continent** is built up of two ancient *plateaux* and two recent *basins*.

The larger plateau is that of the *Brazilian Highlands*, the smaller is that of *Guiana*. These plateaux recall those of the eastern half of *Africa* and the western half of *Australia* (note the prevalence of *plateaux* around the *Indian Ocean*, in contrast to *cordilleras* on the *Pacific border*).

The Andean Chain and these ancient plateaux determine the position and the form of the basins of the South American Continent.

The northern basin of the *Orinoco* is shut in by the *Guiana Highlands* and the *Andes*; a lateral cordilleran branch of the Andean Chain cuts it off from the *Caribbean Sea*. It opens to the Atlantic in a great delta just outside the Caribbean wall of the *Lesser Antilles* Archipelago.



(Vertical scale grossly exaggerated.)

FIG. 377.—SECTION ACROSS THE AMAZON BASIN THROUGH CALLAO AND PARA.

The immense basin of the **Amazon** is limited by the *Guiana Highlands* on the north, the *Andean Cordillera* and its *Bolivian plateau* on the west, and the huge mass of the *Brazilian Highlands* on the south, quite two-thirds of which contribute waters to the Amazon. The slopes of the basin are covered with stratified rocks lying normally upon each other, only the lower parts of the basin, along the course of the main stream, being overlain with recent sediments. The *delta* is one of the largest in the world.

In contrast to the *broad basin* of the Amazon, is the *longitudinal trough*, occupied by the Republics of the Plate River, and drained by the *Paraguay* and the *Uruguay*. The Paraguay follows the foot of the Brazilian Highlands, and receives numerous tributaries, which drain in parallel courses across the long slope of the Andean chain. South of the Plate River mouth, the trough of the Paraguay-Uruguay basin is continued, as a single slope, to the extremity of the continent at Cape Horn in the *pampas* and *stone-wastes* of *Patagonia* and *Tierra del Fuego*.

There is little room for the development of *coastal plain* on the continent of South America.

Only where the three basins open out on the seaboard is this possible. The plateaux of Guiana and Brazil slope *gently* down to the coast line. The western wall of the Andes falls *precipitously* to the Pacific shore-strip, which again falls suddenly, without much continental-shelf development, to deep ocean conditions within 100 miles of the shore.

On the *Atlantic* seaboard a fairly broad *continental shelf*, about 200 miles in average width, extends from *Trinidad* to *Cape San Roque*, and receives the heavy silt-loads of the *Orinoco* and the *Amazon*.

The broadest development of submerged platform is along the Atlantic Borders *south of the Plate River*, where the 100-fathom line is on the average 350 to 400 miles from the shore. Our *Falkland Islands* lie on a projection of this shelf.

South America is, therefore, *poor in archipelagos*. Not so compact as Africa or Australia, having *less proportion of desert*, and having been developed by European peoples *earlier* than Central and South Africa or Australia, its *ports* are more numerous and its exports more valuable than those of either of the sister continents beyond "the Line."

CHAPTER II.

Climatic Conditions and their Effect on Vegetation and Agriculture.

[Maps to be studied: Orographical map of South America; Isothermal maps of South America for January and July: Rainfall maps; map showing Zones of Vegetation; Industrial map.]

Apart from the comparatively *unproductive* regions *south of the Plate River and Valparaiso*, the Continent of South America falls *within the Tropics*. From the point of view of agricultural development and possibilities, South America, therefore, closely resembles Africa and Australia.

Tropical countries vary greatly in character according to *elevation* on the one hand, and *rainfall* on the other. **Difference of rainfall** gives rise to *contrasts* in the character of the vegetation of the three basins opening out to the Atlantic Ocean. The Highlands of Brazil and Guiana show gradual transition from *tropical vegetation* on their lower slopes and in their deep valley to *savannah country* and grass with shrubs on the culminating tablelands.

The *long wall of the Andes*, with many volcanic peaks towering 20,000 feet above the sea (less than 200 miles away), is a remarkable *climatic barrier*, confining all rain from Pacific sources to its western flanks; its lofty slopes present *zones of vegetation*, only to be found elsewhere in the even loftier Himalayas. A gradual and complete transition from

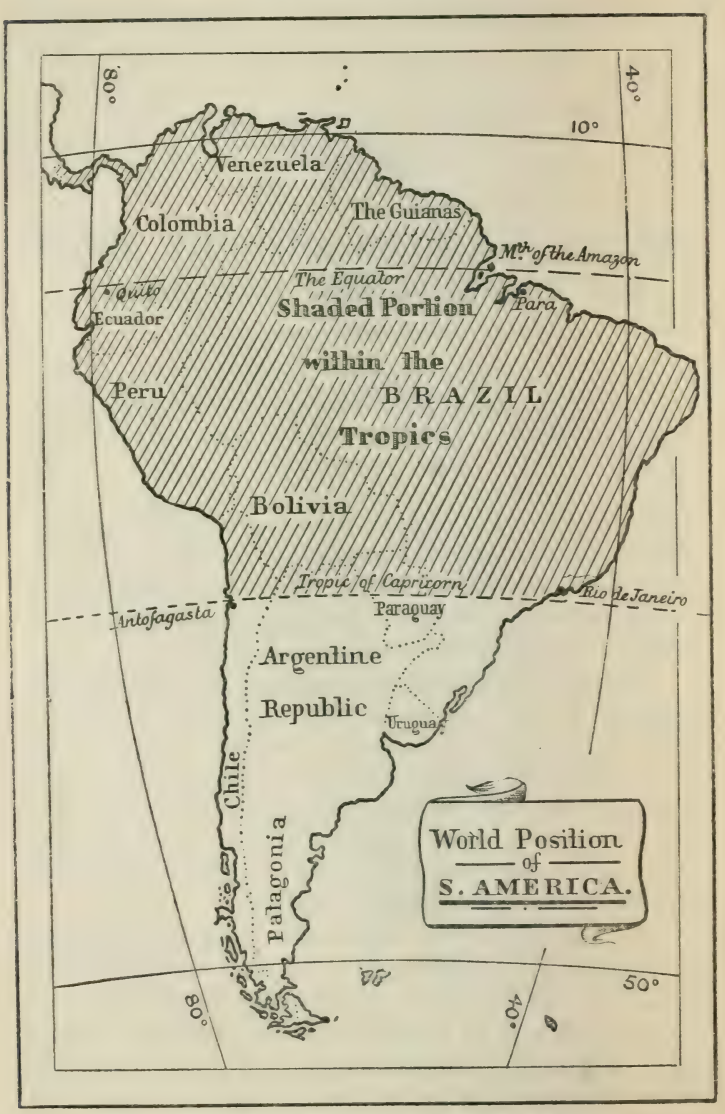


FIG. 378.—WORLD POSITION OF SOUTH AMERICA.

Tropical to Arctic conditions is observed in climbing the few miles of the western slope of the chain *in the torrid zone.* The *snow line* at the Equator is some 16,000 feet above the sea level; in the Andes of Tierra del Fuego it sinks as low as 5,000 feet and *glaciers* are fairly common on the Pacific slope.

The three great basins receive their rains from Atlantic sources. The **Amazon Basin** is the rainest region on the continent. The annual fall averages 80 inches. Quite *three-fourths* of the basin is *below 600 feet* in altitude. The temperature varies very little throughout the year, since *days are nearly equal in length* all the year round. Such climatic conditions are ideal for *tropical forest*, and the Amazon basin offers the most extensive area of tropical forest in the world · at present largely undeveloped. The rainfall occurs in the early part of the year.

The **Orinoco Basin** presents considerable contrast to that of the Amazon. It receives its rain in *two seasons* (Spring and Autumn), which tends to temper the heat of the basin. Rainfall is not sufficient to support tropical forest, though it is comparatively heavy.

Savannah country, well-wooded grass-lands and prairie are characteristic of this basin. The upper valleys and slopes recall those on the rim of the Amazon basin, and are forested with *cinchona trees*, the source of the medicinal peruvian bark and quinine.

The **Guiana coastlands** between the deltas of the Orinoco and the Amazon are more akin to the Amazon "*selvas*" than to the "*llanos*" of the Orinoco.

The long trough of the **Parana-Paraguay River-system** is shut out from Pacific rains by the lofty "rain-barrier" of the *Andes*; it is also impoverished by the partial condensation of the Atlantic rain-winds which blow over the **Brazilian plateau** before striking across the lowlands of the trough. Rainfall here sinks to the *low average* of thirty inches a year. This is *insufficient to support forests*; only the rainier slopes

carry *cinchona trees*, with a belt of tropical forest in the warm valley. The dry plain is typical *prairie country*; the name "prairie" here gives way to the term "*pampas*." *Wheat culture* is here a possible profitable development; at present the pampas are covered with *stock-farms*. *Horses* are reared by the thousand, *cattle* by the million; *sheep* of the merino breed thrive on the dry plains.

Two regions of peculiar interest from the point of climatic conditions deserve our special notice, *viz.*, the rainless **shingle-desert of Patagonia** and the equally arid **Atacama Desert,** the former in temperate latitudes on the Atlantic slope, the latter under the Tropic of Cancer, on the Pacific slope.

The absence of rain in Patagonia is due to the fact that the prevailing winds in that belt of latitude (40°S.—55°S.) are *westerly*—"The Brave Westerlies"—these strike the Pacific flank of the Southern Andes and are tapped of their moisture before reaching the summit of the ridge. They descend the eastern slope, therefore, robbed of moisture and becoming drier as they descend from cold altitudes to warmer levels on the plain. The wet western slope of the range carries the *pine forests* of Chile. The long slope of Patagonia is one expanse of barren shingle.

In the case of the **Atacama Desert** the conditions are different. The strip of desert is on the Pacific border. The rainy Amazon region lies over the Andean plateau of **Bolivia,** which now acts as a rain barrier to rain-winds blowing in from the Atlantic. No rain-winds blow in *normally* from the Pacific; their general direction in these latitudes is *north-east*, giving rise to the "monsoons" of equatorial latitudes on the coast-lands of **Ecuador** and the **Isthmus of Panama.** A low *coast-range* cuts off the desert from the grassy shore-lands. Agriculture is equally impossible in Patagonia and the Atacama desert, but in the latter the loss is compensated for by the presence of valuable *deposits of nitre and guano* which remain *undissolved* in the absence of rain.

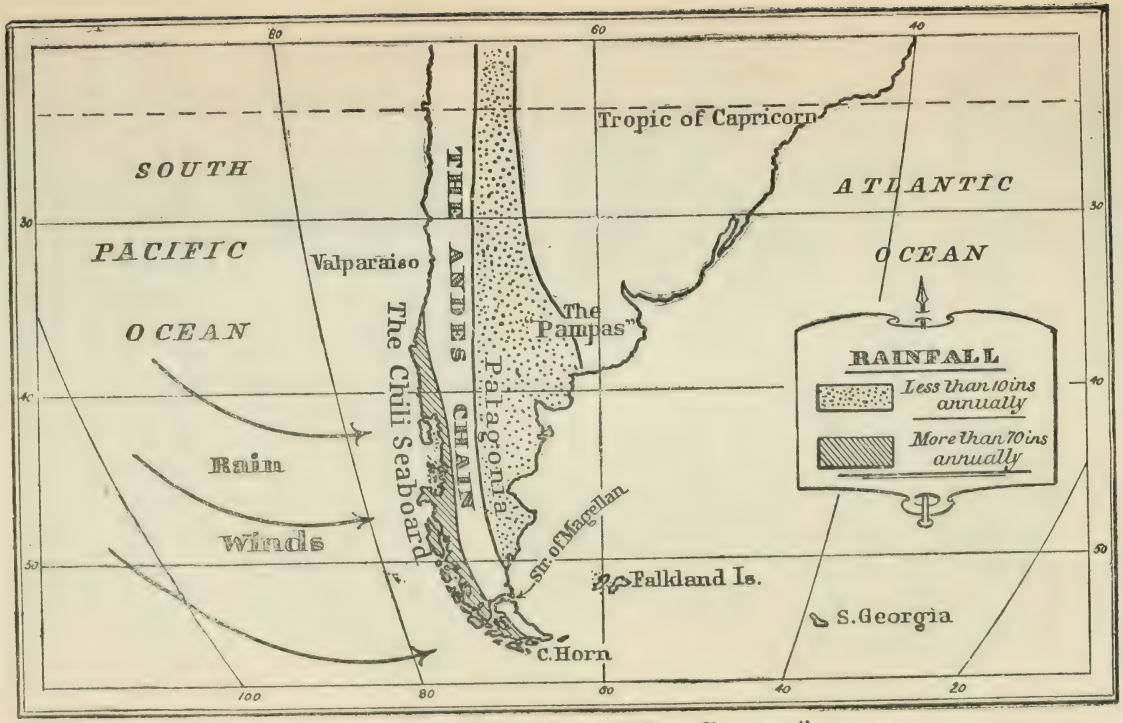


FIG. 379.—THE ANDES "RAIN-BARRIER."

The climate of the Pacific *Gulf of Panama* is *monsoon in type*, but much less marked than that of the Indian Ocean.

The **Basin of the Magdalena**, opening out to the Caribbean Sea, has an individuality of its own, shut in between the main range and a lateral branch of the Andes, and opening, unlike any other South American basin, to the north, whence it receives its rains.

Similarly, the **Basin of the San Francisco** and the numerous smaller valleys opening out to the Atlantic from the Brazilian plateau between its angles of *Cape San Roque* and *Cape Frio* has a climate all its own, and the well-watered slopes of the numerous valleys support the great *coffee* and *cacao* plantations for which Brazil is famous. Such plantations thrive in all the *seaward valleys* in the *rainy belt*, from Eucador on the Pacific, along the Caribbean shore, the Guiana coast, and the Brazilian shore-lands to the mouth of the Plate River. The hot, damp coastal plains support *sugar plantations* and *rice-fields; cotton* is but little cultivated. A very wide-spread crop is that of *manioc*, the source of tapioca.

Isotherms.—The *distribution of the rainfall* and the *arrangement of the highlands* are the two factors which determine the irregularities of the isothermal lines over the continent. *Heavy rains* tend to equalise the temperature by liberating heat in the colder season of the year; combined with *days which vary very little in length*, as in the Amazon Basin, the variation in temperature is very slight throughout the year.

Thus the summer and winter isotherms are both 80°F. in the tropical forests of the middle region of the Amazon Basin.

The **Summer isotherms** show the greatest irregularity; they bend very acutely north over the Pacific shorelands and strike almost due south for nearly a thousand miles along the axis of the Andes. Thus a place A, anywhere from 600 to 1,000 miles

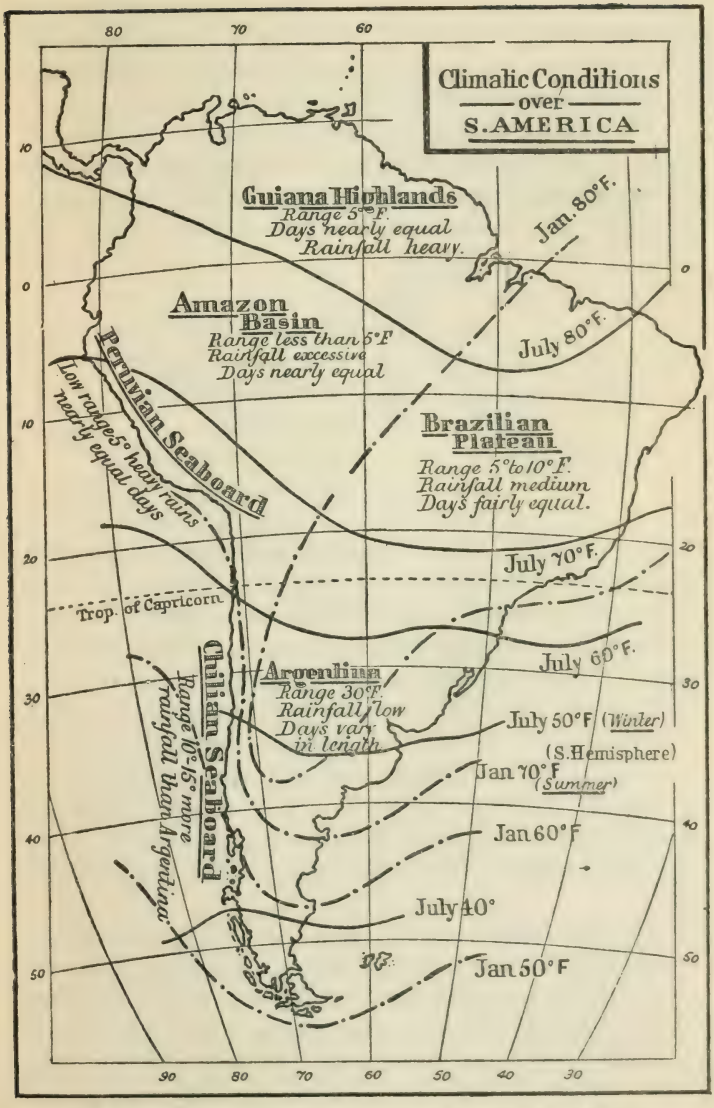


FIG. 380.—CLIMATIC CONDITIONS OVER SOUTH AMERICA.

south of B has summers equally warm; A is more favoured by warm drifts, B is cooled by sub-arctic currents driving coastward from the south. A has longer summer days than B, being farther from the Equator (Fig. 381).

The **winter isotherms** are much less irregular in form, and point to *more regular distribution of temperature according to latitude* (and therefore according to varying length of day). The bends are similar to those of the summer isotherms but

FIG. 381.

less pronounced. A has now shorter days than B whilst other conditions have not varied much; hence, if it were not for the warm drift it would be considerably colder than B; but the effect of the warm drift is not sufficient to obliterate the effect of latitude (in shortness of winter days) so A is distinctly colder than B in winter, lying as it does south (*i.e.*, further from the Equator) of the winter isotherm through B.

We thus see that *summers are hot nearly everywhere on the South American Continent*; it is in *winter* that the temperatures of the temperate belt *vary* most widely, in the direction of being much colder, from those of the sub-tropic zone.

The **dry regions** are on the *tropic limit* (Atacama) or outside it (the Pampas and Patagonia); they tend to become *exceptionally hot* under long days of summer sun-heat; they tend to have *bitterly cold dry winters* in the short days of December and January. Such are regions of *extremes*. The range reaches a maximum of 30°F. between summer and

winter on the "pampas." It would be considerably higher if it were not for the fact that the southern part of the South American Continent is *so narrow as to be open to oceanic influences, both from the Pacific and the Atlantic.*

On the *Andean Cordillera* and the *Bolivian Plateau* great extremes between *mid-day heat* and *midnight cold* are experienced, as on all lofty ranges. At the snow-line the heat of noon is tropic in intensity; at night the air has the "tang" of a dry day in mid-winter.

It is not difficult to distinguish **five main types of vegetation** in South America.

1. The *tropical forest* of the Amazon basin and the well-watered valleys of Brazil, yielding cabinet woods rubber, and palm oil.
2. The higher belt of *cinchona trees*, affording quinine and medicinal bark.
3. The *coffee and cacao plantations* on the seaward slopes from Ecuador to Brazil.
4. The *sugar and manioc plantations* of the coastal plains on either side of the Amazon delta.
5. The "*llanos*" of the north and the "pampas" of the south, grassy prairies supporting herds of sheep, horses and cattle.

The "*Pampas*" alone are in temperate latitudes.

The *tropical forest* is the least developed of these sources of wealth. The plantations and the stock farms have long been in a prosperous state of development. The *cinchona forests* are now being largely exploited and *rubber* is beginning to take an important place among the exports of the Amazon "selvas." The thick vegetation of these selvas has hampered their development. The *Amazon and its tributaries* have been the only "*highways*" through the dense mass of the tropical forest, and they have been dangerous to the traveller by reason of their unhealthy swamps and their dangerous reptiles. The rubber is obtained from the sap of creepers

which make up much of the undergrowth of the big trees of the tropical forest.

We now are in a position to see how South America can be divided up into geographical units. (*See p.* 168.)

TABLE OF GEOGRAPHICAL UNITS.—SOUTH AMERICA.
Compare Tables for Africa and Australia.

LATITUDES.	EQUABLE.	INTERMEDIATE TYPES.		EXTREME.
TROPIC.	The Caribbean Depression.			
	The Basin of the Amazon.	The Brazilian Plateau.	The Basin of the Orinoco.	
	The Peruvian Seaboard.			
TEMPERATE.			The Parana-Paraguay Valley.	The Small Atacama Desert.
		The Chilian Seaboard.		
			The Rain-shadow Slope of Patagonia.	
ARCTIC.		The Falkland Group.		

Below we summarise the chief features of the separate units of the continent. The student is advised to make a small sketch map from any good atlas to illustrate each paragraph, one for each geographical unit.

GEOGRAPHICAL UNITS OF SOUTH AMERICA.

THE CARIBBEAN DEPRESSION.—The southern edge of this sea-filled depression belongs to the South American Continent. It has an average latitude of 10° N., and is bounded by an eastward striking spur from the main North-South Axis of the American Continents. The narrow, unhealthy isthmus of *Panama* forms the western wall of the depression. *Trinidad* is an island outlier of the spur just mentioned. The *Lesser Antilles* continue the girdle as the summits of

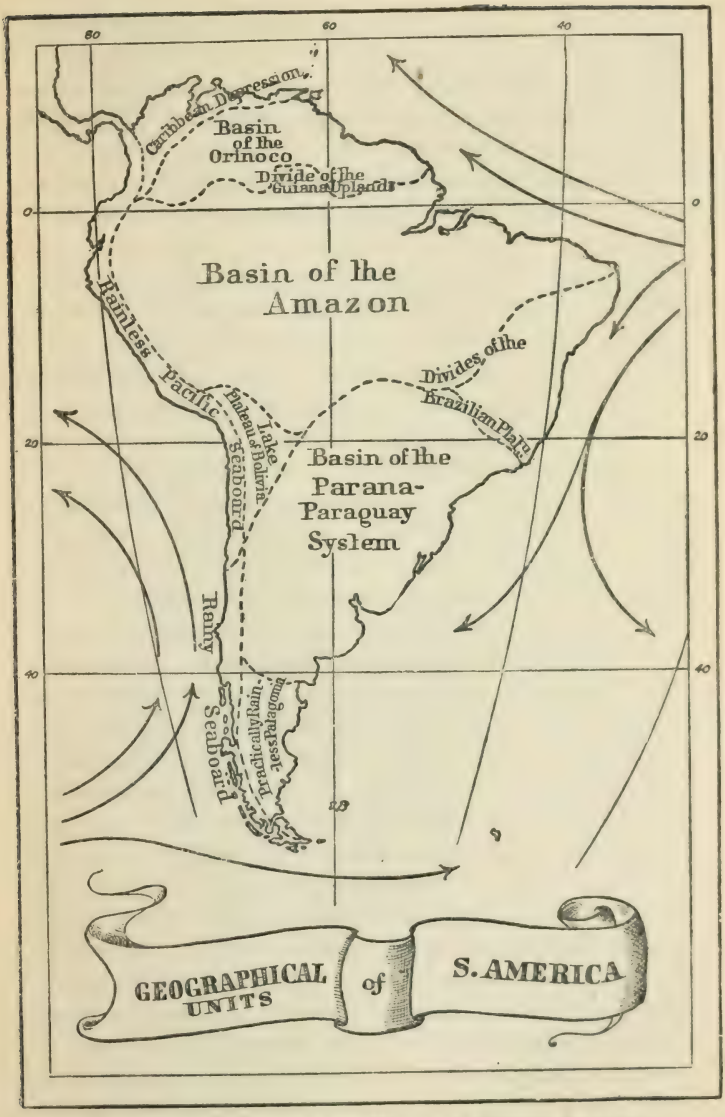


FIG 382.—GEOGRAPHICAL UNITS OF SOUTH AMERICA.

a sunken ridge. Heat is intense, though tempered by oceanic influences. Rainfall is medium, accounting for the prevalence of *savannah* rather than tropical forest. The hot, steaming climate is unhealthy. *Bananas* and *oranges* thrive. *Coffee* and *cacao* can be profitably cultivated; *cotton* is grown on the coast-lands, as is also the *sugar-cane*. *Manioc* is a staple food. The warm waters of the Caribbean Sea afford *pearl fisheries*.

The Basin of the Orinoco.—This basin affords a striking contrast to that of the Amazon, which lies next to the South, separated by the E.W. axis of the *Guiana Highlands*. Shut in somewhat closely by highlands to north and south, the upper valley of the Orinoco is covered with *llanos*, fertile grass lands, on which trees are scarce. Rivers are, however, numerous. *Sheep* and *cattle* can be reared without fear of droughts, such as visit the Australian stock-raising centres. The coastal strip is partly occupied by the Guianas—British, Dutch, and French—whose hot, damp, alluvial coastal plains grow the *banana*, the *orange*, *rice*, *cotton* and *sugar*.

The Basin of the Amazon.—This huge catchment-area, bisected by the Equator, presents many points of resemblance to the *Congo Basin* of Africa. But its rainfall is even heavier. Only the *Lower Ganges* and the *East Indian Islands* can compare with it in this respect. The lower parts of the basin, and especially the low plateau on which the innumerable headstreams gather to form the trunk river, are covered with *tropical forests*, the grandeur and solemnity of which are unrivalled. Here is a great, undeveloped land of *oil* and *rubber*. Climate and undergrowth make pioneering difficult. The river carries more water—and silt—to the ocean than any other stream. The ocean is discoloured by its contribution for three hundred miles from the mouth. The sweep of the *Equatorial current* keeps the estuary open.

Lake Plateau of Bolivia.—The *Andes* lose their characteristic chain-structure in the region of Bolivia, where they

expand into a *triangular plateau, with lakes*. The plateau stands more than 12,000 feet above the sea, only some 250 miles away on the Pacific side. The cone of *Atacama* stands sentinel on the southern edge in the latitude of the Tropic of Capricorn. The slopes from the tableland towards the Amazon and the Paraguay support sub-tropical forests.

Brazilian Highlands.—A low "divide" strikes W.-E. from the Bolivian lofty plateau to the broad tableland of Brazil, whose average altitude is not more than 3,000 feet. The "divide" separates the drainage area of the *Amazon* from the valley of the *Paraguay*. The plateau of Brazil sends out a radiate series of feeders to both basins, as well as to the Atlantic. The tableland occupies practically the whole of the "elbow" of the continent, leaving little room for a coastal plain. It is practically confined within the *Tropic Belt*. *Bananas* and *oranges* grow in abundance on the seaward slopes. *Tropical forest* occurs in the valleys. *Coffee* of excellent quality is cultivated. *Cedar* and *rosewood* are the principal timber exports. *Sugar* and *rice* are cultivated, as usual, on the damp, tropical plains.

The Peruvian Seaboard.—The high wall of the folded *Andes Chain* determines the outline of the *Pacific seaboard*, and leaves only a strip of land between the culminating ridge and the parallel shore-line. Equilibrium has not yet been attained in these lofty ranges, with the result that volcanic and seismic phenomena are common. *Chimborazo* and *Cotopaxi* are among the world's volcanic giants. Near them stands the upland city of *Quito*, on the Equator. From the Equator to the latitude of *Valparaiso* (30° S.) the coast is remarkably *poor in rain*, owing to the fact that here air-circulation is *away from* the continent. Extreme conditions occur in the small *Atacama Desert* (belonging to Chile), under the *Tropic of Capricorn*. Here *guano* and *saltpetre* deposits remain undissolved by rains, a harvest for the manufacturing chemist. *Sheep*, of cross-bred type, are reared on the more fertile strips,

North of Quito rain is more plentiful; the heat is tropical, and *tropical fruits* are grown. It is to the *mines*, rather than to tillage or vegetation, that *Peru* owes its wealth.

Rainy Pacific Seaboard of Chile.—South of the remarkable *Atacama Desert*, the coast-lands between the Andes and the Pacific receive considerable rain. Indeed, here the continent receives its rain *from the Pacific*, and not as is usual, from the Atlantic. The Andes form a remarkable "*rain-barrier*" from Valparaiso to Cape Horn (*see* Fig. 379). West of the rain-barrier shown in Fig. 379 are found the shingly desert of *Patagonia* and the *Pampas*. The Pampas are grassy plains occupying the southern and drier section of the Plate River drainage system.

The Parana-Paraguay Basin.—This comparatively dry region almost coincides with the *Argentine Republic*. The rivers receive their waters from the rainier highlands of *Bolivia* and *Bazil*. Whilst *tropical forests* occupy some of the warmer valleys, the broad plain is best adapted to *stock-raising* and *wheat-growing*. The *silkworm* is abundant, but not made use of. *Wool* and *meat* are the staple exports of the most advanced republic on the South American Continent.

The Falkland Group lie on a projection of the *continental shelf* eastward from the shingle desert of *Patagonia*, and within equal distances of the *Straits of Magellan* and *Cape Horn*. Their average latitude corresponds to that of *England*, but their summer temperature (January) is 10° F. colder than ours (July), whilst their winter average is 4° F. lower. This is due to *Antarctic currents*, which sweep round *Cape Horn*. The climate is equable, though rainfall is only medium. The rocky soil is better than that of the mainland rain-shadow region. *Port Stanley* exports *wool* and *tallow*; it also collects *sealskins* from the scattered islands (belonging to the Empire) which lie farther south in colder latitudes.

South Georgia is a group of islands away farther south.

EXERCISE:—From your atlas fill in the various data needed to complete this table.

(Compare your table with that on p. 712).

GEOGRAPHICAL UNITS.	CLIMATIC DATA.					AGRICULTURE.				DENSITY OF POPULATION.
	SUMMER t°.	WINTER t°.	RANGE OF t°.	RAINFALL.	ELEVATION.	NATURE OF SOIL.	CROPS.	CATTLE.	SHEEP.	
The Caribbean Depression										
The Basin of the Orinoco										
The Basin of the Amazon										
The Peruvian Seaboard										
The Brazilian Plateau										
The Parana-Paraguay Valley										
The Atacama Desert										
The Seaboard of Chile										
Rainless Patagonia										
The Falkland Group										

CHAPTER III.

Mineral Resources of the South American Continent; Discovery and Development; Commercial Relations and Internal Communications.

[Maps to be studied: Geological, Commercial, Political and Population Maps; Trade Routes of the World.]

EUROPEAN adventurers were first attracted to South America by the reports brought home from the West Indies of the *vast stores of mineral wealth* in the Andes, especially of **silver.**

The silver mines occur on the cordillera in the "core" of the *Andean chains*, where ancient rocks are thrust up to the surface. The average altitude of the mines is over *10,000 feet.* Some **gold** and **copper** occur, as is usual, with the silver ores. Gold is more common on the ancient plateaux of Brazil and Guiana, and here it is accompanied by **diamonds** (*cf.*, Transvaal).

The valuable ore could be shipped from ports on the Pacific seaboard less than 200 miles away.

Historical Notes.—In that remarkable "age of discovery" following upon *Columbus'* perilous venture across the Atlantic, South America soon became the objective of *Spanish* and *Portuguese* sailors who had trafficked in the West Indian islands and on the Mexican isthmus.

Pope Alexander VI. decreed that Spain might operate west of a line equivalent to longitude 45°W., and Portugal east of that line. This gave **Brazil** to *Portugal* and the **Andean Cordillera** to *Spain.* In this way the Spanish ships were soon laden with treasure from the silver resources of the cordillera. But the Spaniards found here, as they had done in Mexico, a people advanced in civilisation and in the mining arts, dwelling upon the healthy cordillera—the nation ruled by the *Incas*, whose capital was at *Cuzco* and whose memorials still remain in many an impressive ruin and ancientroad upon the plateau. Spain soon came into conflict with the Incas and within fifty years had conquered them (1533). Spanish rule brought oppression to the native peoples, who in time overthrew their Spanish oppressors early in the nineteenth century (1810), and set up small republics in different parts of the old Incan Empire which extended along the chain from *Ecuador* to *Bolivia.*

The **Portuguese** gained *Brazil* in 1500 A.D., only eight years after Columbus had crossed the Atlantic, and two years after he had sailed into the mouth of the *Orinoco.* They held it for eighty years, when **Spain,** which overshadowed Portugal from the middle of the sixteenth to the middle of the seventeenth century, took it from them. The **Dutch,** however, then rising into prominence as a maritime and colonising nation, supported Portugal's claims to Brazil, and disputed Spain's right of empire.

Portugal became an independent monarchy in 1815, after the close of the Napoleonic Wars, and Brazil separated, to become an independent empire, only to follow the other states of South America, and become a republic, in 1889. Nothing, therefore, is left to Spain or Portugal on the continent of South America. The great bulk of the population, however, are descendants of the two nationalities, living side by side on the South American continent, as their ancestors did on the Iberian peninsula.

Spain developed the mineral resources of the *Andes*; **Portugal** cultivated the shore-lands and seaward slopes of the eastern highlands. *Silver* and *gold*, *coffee* and *cocoa* were the earliest contributions of the continent to European needs.

The *Guiana Highlands* and their foreshore fell to the lot of other European nations in various international struggles. The French gained a strip of country in 1664; the Dutch another contiguous to it in 1667, as a solatium for the loss of New Amsterdam, now New York. **British Guiana**, after many changes, came finally into our possession in 1815.

The off-lying archipelago of the **Falkland Islands**, discovered in 1592, became a British Crown Colony in 1833.

Commercial Possibilities and Lines of Transit.—Practically all the large towns of South America are *seaports*. They have grown up as gates of trade for the export of the products —mineral and agricultural—of the continent. The export from the Pacific ports has been almost entirely *mineral*, that from the Atlantic ports is predominantly the *products of the soil*, of the *forest* and the *stock-farm*.

Only two large towns are found in the interior, and they occur on the healthy cordillera as centres of rich *mining* resources and *capitals* of republics. *Bogota*, the capital of COLOMBIA, is as large as Halifax or Gateshead; *Quito*, the capital of ECUADOR, the highest city in the world, and on the Equator, has a population just over 50,000.

But neither of these towns can compare in population or importance with the great ports of the continent. **Buenos Aires** ("Good Air")—1,130,000—is as big as *Glasgow* or *Hamburg*, and the gate of the ARGENTINE REPUBLIC.

Rio Janeiro, the principal outlet for BRAZIL, is a larger port than *Marseilles* or *Bristol*. *Santiago*, the gate of Chile, is as large as *Hull*. *Montevideo*, the port of little URUGUAY, is as busy as *Havre* or *Belfast*.

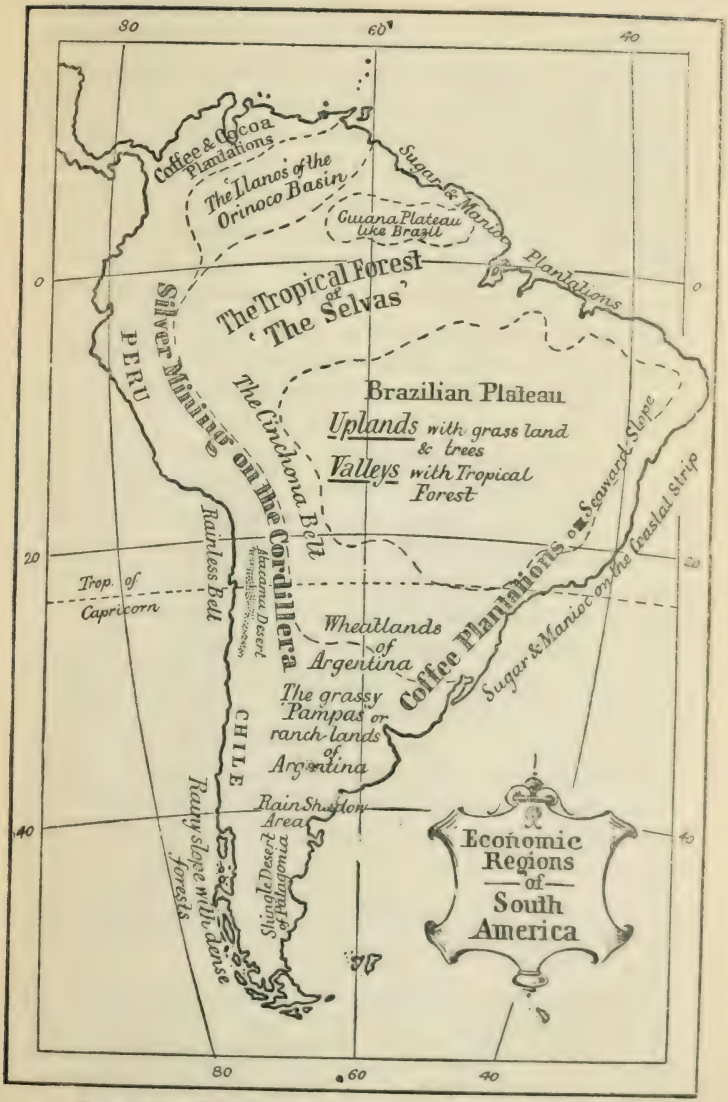


FIG. 383.—ECONOMIC REGIONS OF SOUTH AMERICA.

Other important ports are *Bahia* and *Pernambuco* in Brazil; *Lima* and *Valparaiso* on the Pacific; *Rosario* on the Plate River; *La Guayra*, the port of Caracas, in Venezuela ("Little Venice"); *Para* on the Amazon delta and *Georgetown* the outlet of British Guiana. From these facts we can get a fair notion of the *state of development* and the *commercial possibilities* of the different regions of the continent. The *mining centres* of the cordillera, the *salt deposits* of the rainless Peruvian and Chilian seaboard, the *plantations* and shorelands of Brazil and Guiana and the *wheat* and *wool* and *meat* regions of the alluvial plain of the Plate valley are in a fairly advanced state of commercial development. *Patagonia* offers few resources and a bad climate.

Only the **Amazon Basin** remains largely undeveloped. Its *climate* is unsuitable to Europeans. Its *dense vegetation* makes roads and railways almost impossible. The great rivers, the Amazon and its feeders (especially the Madeira) are of necessity the highways along which development must take place. The *upper valleys*, above the tropical forest belt, which are the home of *cinchona trees* and the *coca-plant*, can find outlets for their produce by way of the cordilleran railways to the Pacific seaboard or over the low "divide" which separates them from the head-waters of the Parana-Paraguay rivers, or even across the healthy "Matto Grosso" (Great Wood.) of the Brazilian plateau to the ports on the Brazilian seaboard beyond the tropic (*Rio* and *San Paulo*).

One factor which has helped to make the ports the largest towns on the continent is their *relation to British sea-trade-routes.*

Steamers from the Pacific to Europe may choose the "Cape" route or that around Cape Horn. In the latter case, steamers from Vancouver or San Francisco call at *Guayaquil*, *Callao*, *Iquique* and *Valparaiso*, picking up their exports, the

bulk of which are destined for the Atlantic States of America or the western countries of Europe.

"Tramp-vessels" from the Antipodes touch at *Rio*, *Bahia* and *Pernambuco* before striking across the narrowest part of the Atlantic (in Equatorial latitudes) for the European ports.

British trading-fleets which gather up the produce of the West Indian Islands also call at *Colon*, *Savanilla*, *La Guayra* and the three capitals of the Guianas. *Kingston* (Jamaica), *Barbados*, *St. Thomas* and *Colon* are the four ports on which trade routes converge.

Railways.—Railways have developed most on the lowlands of the *Plate River Republics*—ARGENTINA, URUGUAY and PARAGUAY. They are easily made, and when the rivers were not sufficient to cope with the increasing traffic, railways were built to supplement and largely supersede them. The natural bases from which these lines would radiate are *Buenos Aires* and *Monte Video*, the former for Argentina, the latter for Uruguay. Then both systems penetrated inland by radiating lines to the foot of the Andes, along the productive river-valleys and across the Pampas. The two systems link up in the upland and inland republic of Paraguay.

The mines of the cordillera must, sooner or later, find quick means of transport down to the seaboard. But the *Andes* are well-nigh impassable, even for roads, not to speak of railways. Engineers persevered, seeking out passes by which to carry a railway to the level of the Cordilleran plateau. Little difficulty faced the engineer in carrying his lines along the inter-mont valleys of the Cordillera. The line of development of Peruvian and Chilian railways is, therefore, one of short, steep mountain-railways from the ports to the tableland, with a series of linking lines running along the plateau from centre to centre of the mining belt.

The Cordilleran railways are thus brought within reach of the head waters of the Amazon streams; the Argentine

railways have pushed back to the eastern foot of the Cordillera. In one case the line has been carried up to the cordillera, and now (1912) links the two great ports of *Buenos Aires* (Argentina) and *Valparaiso* (Chile) *viâ* the Uspallata Pass.* Everything points to another line from Buenos Aires, which is already constructed as far as *Jujuy*, being carried forward to join the upland railway on the Bolivian silver-mining plateau.

The railways of Brazil are mostly short, independent lines penetrating the coast valleys from the ports as far as the limits of the plantations, or to the centres of mining industry. The mines are chiefly in the "MINAS" province, at the source of the *San Francisco*. The nearest seaport is "*Rio*," hence the railways from these mining centres drop down to that port and the neighbouring port of *San Paulo*.

The three Guianas have only short railways. Their busy regions are on the coastal plain within easy access of ports.

The ports of South America may be grouped as follows:—

1. Bases of trade on the Caribbean Sea and the Gulf of Panama.
2. The outlets of the Guianas and the Amazon Tropical Forest (Brazil).
3. The gateways of the Brazilian Plateau.
4. The Plate River ports.
5. Export centres on the seaboards of Peru and Chile.

1. Trade on the Caribbean Sea and the Gulf of Panama.—COLOMBIA and VENEZUELA are the two republics whose ports are on these waters. The boundary is ill defined. In Colombia the Andean Ranges trend north-ward and the intermont valleys open to the *Caribbean Sea*. The largest of these is the basin of the *Magdalena*. COLOMBIA has also a

* The PAN-AMERICAN scheme proposes to link up the railways of North and South America by lines running along the Andean plateau more or less parallel to the coast. Already many of the railways from Pacific ports have reached Andean centres, which are being linked up by lines on the plateau.

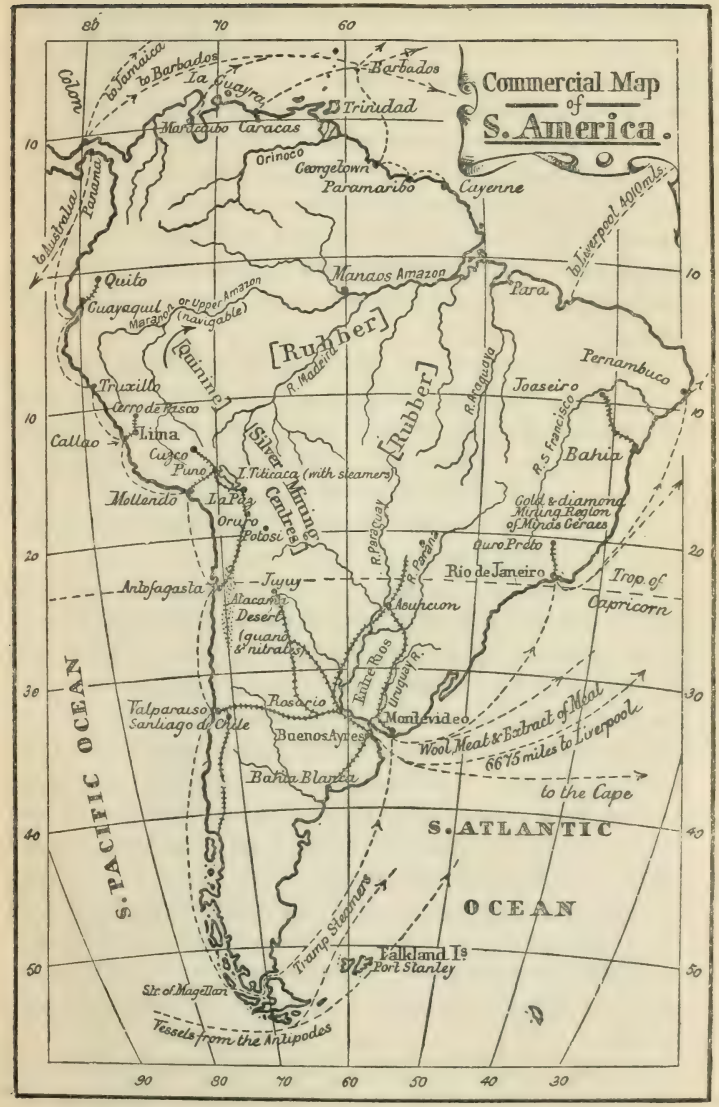


FIG. 384.—COMMERCIAL MAP OF SOUTH AMERICA.

narrow coastal plain on the Pacific. Here principal ports on the Caribbean Sea are *Cartagena* and *Baranquilla*, both near the outlet of the Magdalena Valley. *Buenoventura* serves the Pacific coastal plain. The ports of Colombia may expect to gain in importance when the *canal across the isthmus* is completed. The isthmus forms the independent state of Panama. *Colon* on the Caribbean side of the isthmus and the Atlantic gate of the canal recalls the days of *Columbus*, being the Spanish form of the great discoverer's name, whilst Colombia is evidently named after him too. *Coffee* and *cocoa* are the principal exports.

The mountain axis of VENEZUELA (Sp.=Little Venice) is east-west in trend on the whole. It terminates in the off-lying *British Island of Trinidad*. North of the axis there is the lake-basin of *Maracaybo* and a strip of coastal plain. The lake is shallow and unnavigable; it is really a *lagoon* (*cf.* Venice) separated by a sand bar from Caribbean deep waters. *Port Maracaybo* is outside the bar.

La Guayra is the great port of Venezuela. A railway links it with Caracas, the capital of the republic. No railway crosses the coast range to tap the resources of the "llanos" of *Orinoco*. The flow of the Orinoco is deflected eastward by this coast range, so that the natural gateway of the "llanos" is at the river-mouth, outside the Caribbean depression and on the open Atlantic. The mouth is a huge delta and carries no port of importance. *Angostura* (the "narrows") can be reached by small vessels. *Sugar* from the damp plain, *coffee* and *cacao* from the seaward slopes of the coast range, and some minerals (*copper* and *gold*) form the staple exports of Venezuelan ports. The mineral resources offer considerable possibilities of development. The possibilities of the "llanos" are in the direction of *cattle breeding* rather than in sheep rearing.

The British island of TRINIDAD is an outlier of the Venezuelan coast range. It is well known for its pitch lake. The harbour

of *Port au Spain* faces the mainland and has trade communication through *Barbados*.

2. **The Ports of Guiana and the Amazon region of Brazil.**—The coastal plain is well suited to *sugar plantations* and sugar is the staple export. BRITISH GUIANA has outstripped both the Dutch and the French colonies in sugar production. FRENCH GUIANA is backward; *Cayenne*, its capital, is an old penal settlement and on a very unhealthy site. The pepper which bears its name is an export. *Paramaribo* is the Dutch capital and has many characteristics of Dutch towns.

Georgetown is the largest of the three capitals and the most important port on this seaboard. It is the outlet of the sugar-growing province of **Demerara**. Its vessels trade *viâ Barbados* with the home country. British Guiana has its railway in a short line from the capital to *New Amsterdam* at the mouth of the *Berbice* valley.

The immense area of the "selvas" of the Amazon is not served by a single mile of railway. The river-highways converge on *Manaos*, which is the natural collecting centre for the *rubber*, the *cinchona* and the *cabinet woods* which are the exports of this as of most tropical forests. *Para* is the seaport—not on the Amazon delta, but on the Rio Para, just to the east. Para is a little more than 4,000 miles from Liverpool, to which it ships the bulk of its rubber.

The two head-streams of the Amazon (the *Maranon* and the *Ucayli*) are within Peruvian territory; they follow intermont valleys on the cordillera. Para is 2,000 miles away. The *cinchona* and *rubber* of the upper valleys will, therefore, find their way to Peruvian ports, and not *viâ* the unhealthy river route through the jungle country of the "selvas."

3. **The Gateways of the Brazilian Plateau.**—In contrast to the unhealthy lowland coast of BRAZIL from *Guiana* to *Cap San Roque* is the healthy foreland of the Brazilian highlands

from *Pernambuco* to within a few miles of the busy estuary of the *Plate River*. The former coast recalls the deadly *Gold Coast* in similar latitudes across the Atlantic; its ports are few in number and comparatively small. The population of *Para* reaches 100,000.

Pernambuco, *Bahia* (San Salvador da Bahia, *i.e.*, on the *bay*) [*cf.*, Kingston-on-HULL], and *Rio de Janeiro* (River of January, because reached on New Year's Day), are three of the finest ports in the southern hemisphere. None of them has a great river behind it. The long valley of *Sao Francisco* has no port of importance at its mouth. Its middle section is served by a railway which crosses the plateau direct from Bahia. The mines around its source find their outlet by more than one line down the short slope to *Rio*.

Pernambuco and *Bahia* have each about 200,000 inhabitants; *Rio*, standing on the Tropic of Capricorn, is as large as Liverpool. Its railways serve the *mining centres*, the *coffee plantations* and the *rice* and *manioc* fields which occupy plateau, slope and coastal strip respectively, along the seaboard. The district of **Ouro Preto** ("precious gold") exports *gold* and *diamonds*. *Diamantina* has a significant name as has also the province in which it occurs (*Minas*).

The small port of *San Paulo* is linked by railway with Rio. South of *San Paulo* the hinterland changes in character, passing gradually into grassland like that of the Plate Republics.

4. **The Plate River Outlets.**—The Plate River is the gateway of three republics—the Argentine, Paraguay, and Uruguay.

Both "Plate" and "Argentine" refer to *silver*, but no silver is mined in these republics. It has been suggested that the reference is to the silvery streams which water the plains of the basin. A striking contrast in climate and contour from the conditions of Brazil lead to an equally marked contrast in the exports of the Plate fleets from those of Brazilian ports.

The plains of the *Parana* and *Uruquay* which unite to form the Plate River (*cf.* Ouse, and Trent, and Humber), are covered with a *network of railways*, and these have thrown off branches like tentacles penetrating the upper valleys and bringing their produce to the gates of export. Three types of country contribute their quota to the trade of this great river-mouth:

(*a*) The *upper valleys*, approximating to the selvas and plantations of Brazil;

(*b*) The *plain of the rivers*, a real "Mesopotamia" (called in one part "Entre Rios);

(*c*) The rolling "*Pampas*" to the south with few streams and no trees.

Jujuy, *Santiago*, *Asuncion* (the capital of Paraguay) and *Corrientes* are centres of trade in the upper valleys of **"El Grand Chaco"** (the grand chase), on whose uplands the native races followed the chase in pursuit of a livelihood.

Parana is the busy locus of the "Entre Rios" area.

Rosario is at the head of the Plate Estuary.

Buenos Aires is the great emporium of the Argentine; it is larger even than *Melbourne* or *Sydney*; it stands on the same latitude line as *Cape Town* and *Sydney*; it is the gateway of the wool, meat and wheat, which are the prime exports of the Argentine.

The important line which negotiates the wild Uspallata pass (El Cumbre) over the Andes, under the shadow of *Aconcagua* (the giant volcano of the Southern Andes), climbs from the plain to the mining centres of *St. Luis* and *Mendoza*.

South of the line from Buenos Aires to Valparaiso no port of importance occurs. *Bahia Blanca* (White Bay) is a naval station. The sand-waste of *Patagonia* has no resources to require an outlet. The forested slope towards the Pacific is largely undeveloped. But from Valparaiso to the Equator the coast is well supplied with ports which act as the gateways of the cordillera.

Export Centres of Chile, Peru and Eucador.—The Republic of CHILE occupies the Pacific seaboard and the Andean slope from Cape Horn to the lake-plateau of Bolivia.

The archipelago of **Tierra del Fuego** ("Land of Fire") is barren and useless. It gets its name from the open fires of the natives, which attracted the attention of sailors passing by the *Cape Horn* route.* The *Straits of Magellan*, named after the discoverer who passed through them on his memorable journey (1521), are now used by "tramp steamers" in passing between the ports of Peru and Chile, and the ports on Atlantic waters. Steamers from the antipodes keep to the "cape" route.

The broken coast of *Southern Chile* recalls that of *British Columbia*, and its pine forests form an additional point of comparison.

A railway has been carried southward from *Valparaiso* as far as the *Chonos Gulf*, where the coast begins to be broken. The forest region coincides with this line, not occurring to the north of Valparaiso.

Santiago is the capital of Chile, and stands on the railway about 60 miles from *Valparaiso*. The railway throws off short lines to the ports, of which *Concepcion* and *Valdivia* are the most important.

Valparaiso (=Val Paradiso, the vale of Paradise), is the largest port on the Pacific shore of South America. It is healthier than the ports of Peru, which fall within the Belt. Valparaiso is the distributing centre of Chile and the chief gate of imports.

The mining centre of *Copiapo* sends its exports by a short railway to *Caldera*, the nearest point on the seaboard.

The rainless region of *Atacama* sends its *nitrate* and *guano* resources by way of *Antofagasta* or *Iquique*. Antofagasta stands at the northern end of the desert strip, and is also

* Cape Horn is in a similar latitude to *Newcastle*, but the climate is much more severe, owing to Antarctic drifts. The limit of icebergs is only a few miles to the south.

the terminus of the railway which taps the resources of the BOLIVIAN PLATEAU, on which *Potosi*, *Oruro* and *La Paz* are the chief silver-mining towns. *Sucre*, the capital of Bolivia, stands away from the railway, on the eastern slope of the plateau and just above the tropical forest belt of El Gran Chaco.

The railway follows the high plateau to the large *Lake Titicaca*, on which regular steamers ply. The northern end of the lake is the frontier of PERU; from it a railway descends from *Puno* by way of the *Arequipo* to the Peruvian port of *Mollendo*. Another section of the line pushes northward from *Puno* to *Cuzco*, the ancient capital of the Incas, and still an important mining centre, close to the head-waters of the *Amazon*.

Away to the north is the mining centre of *Cerro de Pasco*, not linked with Cuzco by rail as yet, but communicating by rail with *Lima*, the capital of PERU and its port, the unhealthy *Callao*. Callao is to Peru what Valparaiso is to Chile, but has only one-fourth the population of the Chilian port.

Lima is a town as large as *Leicester* or *Sunderland*. The Chilian capital, *Santiago*, is half as big again, and comparable in population to Newcastle or Liverpool. After Mollendo and Callao, *Truxillo* is the only important port in Peru.

The mountainous state of ECUADOR* in equatorial latitudes finds its outlet in the harbour of *Guayaquil*. A mountain railway links its docks with *Quito*, the capital of the State, situated in a healthy position high upon the cordillera, and practically "on the line." Standing on the Equator, it has equal days and nights all the year round; as a result its seasons are ill defined; they are rainy and dry rather than hot and cold. Differences of heat and cold are however very marked *between mid-day and mid-night* on such a high altitude. Nights can be bitterly cold in the same week when days are scorchingly hot. Until recently the development of the town has been hampered

* Spanish word for Equator.

by the absence of railways. Now the line is completed, the resources of the high plateau will be worked. Not far from Quito, toward the eastern edge of the cordillera are the giant volcanoes of *Cotopaxi* and *Chimborazo*, each 20,000 feet above the sea, with several other cones 15,000 feet high in the neighbourhood.

State.	Population. / Area.	Population Per Sq. M.	Resources.	State of Development.	Obstacle.
Colombia ..	4·3 million people / 0·48 million sq. m.	=9			
Venezuela ...	2·6 million people / 0·36 million sq. m.	=7			
Brazil	20·0 million people / 3·2 million sq. m.	=6			
Paraguay ...	0·58 million people / 0·14 million sq. m.	=4			
Uruguay ...	1·15 million people / 0·07 million sq. m.	=16·4			
Argentine ...	6·2 million people. / 1·1 million sq. m.	=5·6			
Chile	3·6 million people / 0·3 million sq. m.	=12			
Peru	4·6 million people / 0·7 million sq. m.	=6·6			
Ecuador ...	1·4 million people / 0·7 million sq. m.	=11			
Bolivia... ...	1·9 million people / 0·7 million sq. m.	=2·7			
Br. Guiana ...	0·26 million people / 0·09 million sq. m.	=2·8			
D. Guiana ..	0·078 million people / 0·04 million sq. m.	=19			
Fr. Guiana ...	0·039 million people / 0·03 million sq. m.	=13			

The plateau drains by many streams to the Amazon and shares in the *cinchona belt*, though it does not (like Peru) include tropical *forest* within its frontier. *Guayaquil* like Callao is deadly to Europeans.

In the above table the approximate areas and populations of the different states of South America is given. The student should work out his reasons for the high or low density of the population; whether

1. Poverty of resources; or,
2. Lack of development of the resources which wait to be exploited; also,
3. In the latter case, the obstacles which have retarded development, such as climate, altitude and unsettled government.

Of outlying archipelagos, the South American Continent has few.

The **Galapagos Archipelago** on the Equator, west of Ecuador, is separated by deep ocean from the mainland. It stands away from the trade routes, being too near to the isthmus to be of service to vessels sailing from Panama to the Antipodes.

Glossary of Geological Terms Used in the Text.

Agglomerate.—The mixture of volcanic and sedimentary material found in the throat of a volcano.

Alluvium.—The sandy deposits laid down in the flood-plains, haffs and mouths of rivers.

Anthracite.—A modified form of coal, nearly pure carbon, bright and brittle. Found in folded regions, where pressure and heat have driven off the coal-gas-forming constituents present in ordinary coal.

Anticline.—The ridge-like axis of gently upfolded strata.

Basalt.—A compact, dark-coloured lava, rich in iron constituents.

Boss.—A rounded dome of granitic, crystalline rocks, exposed by the weathering of overlying strata.

Boulder Clay.—*See* "Till."

Coastal Sill, or Foreland.—A flat strip of country running parallel to the shore; usually of a rock-platform character.

Crust-block.—A block of country, roughly polygonal in outline, and bounded by fracture lines, around which the country has subsided to form basins, leaving the tabular mass standing as a plateau.

Denudation.—The wearing down of strata, the crumbling of rocks, by the action of rain, wind, sun and ice.

Detritus.—The rock-waste resulting from denudation, including alluvium (*see* above), gravel, deltaic materials.

Diorite.—An igneous rock of deep-seated origin, very crystalline, greyish, to greenish-black in colour, very compact; richer than granite in iron bearing materials.

Dip.—The general angle of slope of a stratum, or layer, of sediment.

Drowned Valley.—A valley into which, owing to the subsidence of the hilly coast, the sea has crept and formed a firth or fiord.

Dyke.—A vertical fissure in the Earth's crust, in-filled with lava, which has solidified *in situ*.

Escarpment, or Scarp.—The cliff-like inland termination of a layer of hard rock sandwiched between beds of softer materials, exposed owing to the resistance to denudation; often running for miles in ridges.

Fault.—A fracture, more or less vertical, produced in a group of strata by strain in the Earth's crust. The beds on one side have suffered displacement relatively to the beds on the other side.

Flood-plain.—The flat, gravelly meadow-land over which a river meanders, continually modifying its course, and which in time of heavy rains lies under water.

Fullers' Earth.—A clayey, fine earth, found in the strata of Secondary Age. Used in the "fulling" or cleansing of raw wool because it absorbs the oil.

Grikes.—Joints in limestone, widened by the solvent action of rain.

Grit.—A tough sandstone, in which the grains are more than usually angular, and therefore better interlocked with each other (*e.g.*, Millstone Grit).

Gypsum.—Sulphate of lime ($CaSO_4 2H_2O$), occurring in crystals and in fibrous layers; used in the manufacture of Plaster of Paris.

Horst.—A German term for a "saddle" of crystalline igneous rock. Comparable to a "boss" whose inner belt has subsided, giving the saddle form.

Kaolin.—China clay, nearly pure white; derived from the weathering of pure granite.

Massif.—A French term, applied to granitic mountain-cores.

Moraine.—The detritus carried down by glacial action and eventually deposited at the melting end of the glacier.

Oolite (or Roe-stone).—Egg-stone. A limestone built up of minute roe-like grains.

Outcrop.—The termination at the surface of strata which dip below other strata.

Outlier.—A mass of stratified rock (often a hill in dimensions) detached from the group of strata to which it belongs by the agents of denudation.

Roe-stone.—*See* "Oolite."

Schist.—A crystalline rock which easily splits in one direction; generally derived from clays, and reconstructed under the influence of heat and pressure.

Sill.—A tabular, horizontal bed of hard rock (*e.g.*, sandstone), but usually refers to lava-sheets intruded between sediments.

Stalactite.—The icicle-like pendants of limestone hanging from the roof of a cave, deposited from dripping water which has percolated through from the surface.

Stalagmite.—The corresponding deposit spread out on the floor of a cave.

Stratification.—The deposit, by the agency of water, of one sediment upon another in layers.

Syncline.—A trough-like depression in gently folded strata.

Till (or Boulder Clay).—The irregularly bedded clay-with-stones left on the retreat of a glacier, or ice-sheet.

Unconformity.—The case of one group of strata overlying an older group of strata, but out of parallelism therewith, implying a tilting of the earlier group before the deposition of the later beds.

Volcanic Neck.—The consolidated material which fills the throat of a volcano after the cessation of eruption.

APPENDIX.

THE NEW EUROPE AFTER THE WAR: THE MAP AS LEFT BY THE PEACE TREATY OF 1919.

It is too early yet to re-draw the Map of Europe in accordance with the terms of the Treaty of Versailles, 1919. Many problems of race and frontier are still unsolved and outstanding. It is possible, however, to indicate what has been done and what is the nature of the problems awaiting solution.

Germany and *Austria* were spoken of all through the struggle as the **Central Empires** and the term very aptly describes their general situation. It is on the West and East of these Empires that the main problems of race and frontier occur.

The *Balkan Peninsula* has been a hot bed of political strife for centuries and since *Turkey* and *Bulgaria* have suffered defeat along with their Allies, Germany and Austria, the whole Peninsula comes once again into the political melting pot.

Belgium has emerged from the War on the victorious side; *France*, the main theatre of the great struggle, has claims for the readjustment of her frontier.

Italy, which changed over to the side of the Anglo-French "Entente," sought and gains territories populated by Italians, as the fruit of victory.

The Empire of *Austria-Hungary*, a veritable motley of states and races falls to pieces and presents as serious a problem as that of the Balkan Peninsula itself.

Russia has not yet restored order and unity out of the chaos and welter of war. She is divided within herself and must be left to bring unity within her own borders. Republics are springing up all along her western frontier.

The "ancient and honourable" kingdom of *Poland*, so ruthlessly torn asunder by covetous and ambitious monarchs on her three frontiers in the 18th Century, seeks

MAP 1.—THE NEW FRONTIERS OF BELGIUM, FRANCE AND GERMANY (ON THE WEST).

once again to become a free and independent nation—bringing together the Poles of all the three nations who dismembered the old kingdom.

Finland once again hopes to be free and independent now that the throne of the Czars has crumbled away. Never before have such serious problems of the map faced the statesmen of Europe as to-day. Let us look at the proposals:—

Map 1 shows the **Franco-Belgian frontier** of Western Germany, with the buffer state of Luxemburg. (*a*) indicates the small area round the town of *Malmedy*, just to the north of Luxemburg, which has been transferred from Germany to Belgium; it belongs geographically to the latter country. The shaded portion (*b*) is the *Saar Valley*—a coalfield with the fine town of Saarbrucken; here the French are given the right to all the coal for 15 years, as reparation for the loss of coal in Northern France during the war and by reason of damage done by the enemy. This area is to be administered by the League of Nations during those 15 years; at the end of such period, the inhabitants have to vote whether they will go with France or with Germany.

The two provinces of **Alsace-Lorraine** (*c*)—French before the war of 1870, and all along French in sentiment though largely German in speech—revert to the rule of France. *Lorraine* is exceptionally rich in iron-ore. The addition of *Alsace* to France brings the Franco-German Frontier across the Vosges Mountains to the River Rhine. These two provinces together add nearly 6,000 square miles and two million people to the Republic of France.

Map 2 brings out the *problem of races and frontiers* in "**Middle Europe**" in a broad general way.

Slav Races occupy the shaded areas; the Slavs have pushed as far west as *Posen* and *Bohemia* on the northern plains of Europe; another section have pushed as far west as the *Adriatic* across the *Balkan Peninsula*. The former are spoken of generally as the **Northern Slavs**, the latter as the **Southern Slavs.** Between the two is a broad belt of non-Slavonic peoples who occupy practically the whole of the *Danube Valley*. These are the

MAP 2.—THE PROBLEM OF "MIDDLE EUROPE.'

Austrians (Germanic), the **Hungarians** (Magyars—Asiatics, akin to Turks) and the **Roumanians** (Latins—Roman Province of Dacia). Here is a pretty problem for the statesmen of Europe to solve.

Map 3 gives in a general way their solution. (A) The **Poles** of *Poland* (Russia), *Galicia* (Austria) and *Posen* are reunited in the new Poland and granted a *corridor* down their river Vistula right to its mouth on the Baltic. (*Danzic*, however, remains a free port). This involves the separation of *East Prussia* with its fine old capital of Königsberg from its co-nationalists across the Vistula corridor. It was separated by such a corridor before the days of Frederick the Great. (*b*) indicates a doubtful belt, which is to decide for itself whether it will go with Prussia or Poland. It will probably vote German.

The question as to whether Memel (*a*) remains with Germany or goes with Lithuania also remains undecided.

(B) The **Czechs** of *Bohemia* and the **Slovaks** of *Moravia* and the *Tatra Country* have joined to form the republic of *Czecho-Slovakia*. The capital is to be Prague. You will notice how far from being central in position this city is.

(C) The Russian republics—whether stable or not remains to be seen — are on the lines of race; the **Ruthenes** forming *Ukraine* and the **White Russians** "White Russia." On the Baltic, *Lithuania*, with Memel for its port, *Latvia*, with Riga, and *Esthonia*, with Revel, are new republics following racial lines.

[Away in the *Caucasus* and *Caspian* region is the new Republic of **Georgia**, of great future importance in the eyes of the Allies, on account of its vast resources of petroleum.]

(D) In the non-Slavonic Danubian belt, **Austria** is separated from Hungary, but not allowed to join herself to Germany; the fine city of Vienna will undoubtedly sink in importance. **Hungary** loses Transylvania and Banat, which are largely peopled by Roumanians; **Roumania** joins to herself Transylvania (across the Carpathians) and also Bessarabia, taken from her by the Russians in 1878. Her frontier now becomes the *Dniester River*

MAP 3.—ATTEMPT AT A SOLUTION.

in place of the *Pruth*. At one stroke she doubles her population.

(E) The **Southern Slavs** have united to form *Yugo-Slavia* (= South Slav Republic). *Bulgaria*, which in the war was on the opposite side to Serbia, however, still remains apart. Whether Bulgaria is to retain the area marked (*e*), with Dedeagatch as its port on the Ægean, or is to be shut in with sea-outlets only on the Black Sea is not yet definitely decided (May, 1920).*

Greece would like the whole of the coast from (*e*) westwards, but she can no longer shut out *Serbia* and *Yugo-Slavia* from the Ægean; the *Vardar Valley* is to have its natural access to the Greek seas.

The vexed question of the **Turks** in Europe and the problem of *Constantinople* has been solved by leaving Constantinople to the Turks. The *sea-way* from the Black Sea to the Ægean will be internationalised and its fortresses dismantled.

(F) **Albania** is to be administered by Italy on behalf of the League of Nations. This will bring the important base of Valona under Italian control.

(G) **Italy** has gained the Italian-speaking *Trentino* and so rounded off her boundary towards the new and greatly diminished Austria: she has also acquired the Italian-peopled westward slope of mountainous Istria, which gives her the invaluable bases of *Trieste* (commercial) and *Pola* (naval). The Eastern slope of Istria and the valley leading down to *Fiume*—a short belt separating the extended Italy from the new **Yugo-Slavia**—is to be administered by the League of Nations, and will serve as a *corridor* for Austrian trade with Mediterranean ports.

Fiume itself is one of the knotty problems of the peace, as between Italy and Yugo-Slavia. It will probably be internationalised.

The small district of *Klagenfurt* (*d*) has to vote whether it will go with Austria or Yugo-Slavia.

*The latest arrangement is that (*e*) shall go to Greece, and also the larger part of the peninsula on which Constantinople stands. Thus Greece has a sea front on the Black Sea.

Upper Silesia—marked (*c*) on map 3—is not yet dealt with. Its population is predominantly Slav. The region has valuable coalfields and deposits of zinc.

Thus summarily have we glanced at the problems of the map and their solution in whole or in part. Such attempts as have been made to reach a settlement on lines of *race*, of *self-determination*, and of *geographical factors* have been broadly indicated. It re mains to be seen—and only time will show—how far thetnew frontiers and the large number of small states crea ed will make for the peace of the world.

APPENDIX

on

THE PEACE TREATY OF 1919

and its bearing on

THE BRITISH EMPIRE.

GERMANY came late into the field as a colonising Power, with the result that gains of territory were only possible in **Africa, Asia** (possibly) and the **Pacific Archipelagos.**

No less than *ten-elevenths* of Germany's colonies in 1914 were in **Africa;** the rest, apart from the small station of *Kiaochau*, in China, on the Yellow Sea, were island groups in the *South Pacific*, and a fraction (about one-fourth) of the large mountainous tropical island of **New Guinea.**

As the outcome of her defeat, Germany surrenders the whole of her colonial territories. In AFRICA, these were **Togoland,** the **Kameroons, S.W. Africa** and **German East Africa.**

The control of **Togoland** is now divided between GREAT BRITAIN and FRANCE—a narrow strip on the west is added to British *Ashanti*, which places both banks of the R. Volta in British hands; a broader strip, adjoining French *Dahomey*, is transferred to that province (see Fig. 60).

Kameroons comes under French control on behalf of the League of Nations.

German East Africa, with its valuable railway from *Kigoma* (Ujiji) on L. Tanganyika to the Sea at *Dar-es-Salâm*, is transferred to GREAT BRITAIN, under mandate of the League of Nations, with the exception of two small provinces (*a*) lying between *Victoria Nyanza* and *Tanganyika*, which are handed over to the care of the

Belgian Congo. The treaty also provides that the Belgian Congo shall have free access to the railway, and special facilities for stores and wharves at each end of the line (see Fig. 61).

The new **Tanganyika Territory** is more than three times the area of the British Isles; its population is roughly that of *Greater London* ($7\frac{3}{4}$ millions). Only one person in 150 is a European! The resources of this

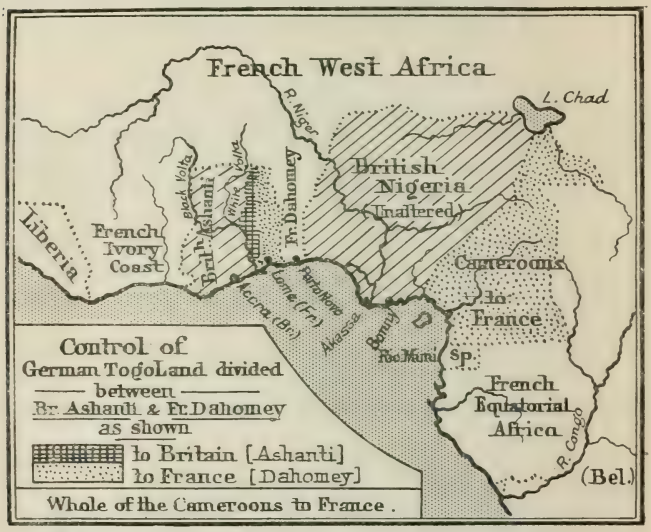


Fig. 385.

territory are very similar to those of *British East Africa*. The rich plantations are naturally on the hot-wet lowlands. Here we may expect great railway developments.

The mandate for **S. W. Africa** is given to the Dominion of South Africa. Its area is only slightly less than that of the new Tanganyika Territory—roughly three million square miles; its population is only equal to that of *Halifax* or *South Shields!* The physical map shows that it is chiefly made up of desert (the *Kalahari*)

and poor grass. *Windhoek* is the capital and stands in the grassland. A railway links it with the outlet (*Swakopmund*) on Walfisch (=whale) Bay. Other lines link the

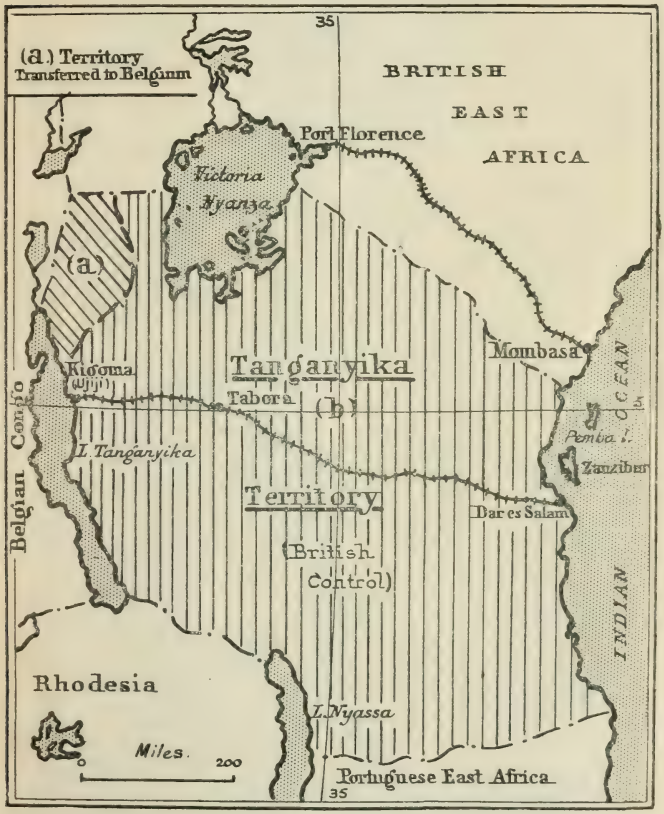


FIG 386.

capital with the mining centres, which are the real sources of wealth in the colony. Diamonds and copper are exported.

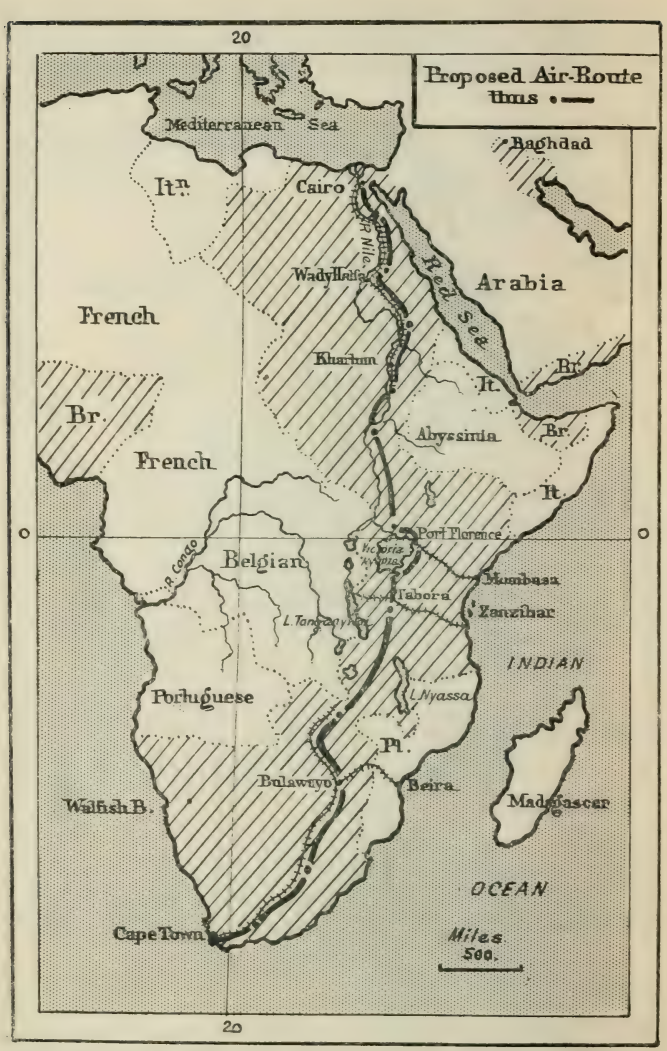


FIG. 387.—ALL-BRITISH CAPE-TO-CAIRO ROUTE SECURED.

Fig. 62* shows how far Cecil Rhodes' dream of an all-British *Cape-to-Cairo route* is being realised.

Air-routes as well as railways are now becoming a serious proposition. The projected ones are shown on the map.

In **Asia,** GREAT BRITAIN secures control of **Mesopotamia,** so the German dream of a Baghdad railway has gone for ever! There are rich resources of *petroleum* in the sands of lower Mesopotamia.† These will be developed by the joint enterprise of Britain and France.

Kiaochau, formerly leased to Germany, is transferred to JAPAN.

In the Southern Pacific, **German New Guinea** is placed under the oversight of the AUSTRALIAN COMMONWEALTH, with the result that the whole of the eastern half of that large island (equal in area to the British Isles) is now under British control. The western half remains a possession of the peace-loving *Dutch.* Along with German New Guinea (or *Kaiser Wilhelm's Land*), AUSTRALIA also acquires control of the off-lying **Bismarck Archipelago.**

The outstanding features of the settlement made by the Treaty of Peace (1919) are:—

(1) The establishment of a **League of Nations,** to whom states holding "mandates" are responsible, and—

(2) The giving of "**mandates**" **to our Self-Governing Colonies,** *e.g.*, S. Africa and Australia, thus placing upon them for the first time *responsibilities beyond their own territory.*

It remains to be seen how these novel but hopeful experiments will work out.

*Opposite Aden, and between Italian Eritrea and British Somaliland, lies French Somaliland (or Obok, with the important port of Jibutil. In area the territory is not large enough to appear on a small scale map.

†September, 1920. "A High Commissioner has been sent by the British Government to set up an independent Arab State, to be governed in accordance with the wishes of the people."

A High Commissioner has also been sent to **Palestine** by the British Government as mandatory on behalf of the League of Nations.

A SHORT INDEX.

Intended to be supplementary to the Tables of Contents.

(*Geographical and Geological Terms in italics.*)

Aiguilles 151
Alabama 522
Alaska 543
Amazon 823
Andes 822
Aneroid 112
Anticline 78
Anticyclone 118
Antilles 545
Antipodes 660
Aphelion 35
Aqueous Vapour 111
Arabs 709
Archipelago 84
Area of the Earth 20
Argentina 845
Arizona 542
Artesian Well 150
Aryans 773
Atacama Desert 828
Atlantic ports 243
Atlantic States 513
Atlas Mountains 710
Atmosphere 108
Austria 406
Auvergne 360
Axis of the Earth 33

Bahamas 623
Balkans 408
Baltic Sea 325
,, Gates of 390
,, Rivers of 386
Barbados 552
Barometers 111
Basalt Plateaux 79
Bathymetric Map 68
Bavaria 405
Belgium 364
Bermudas 623
Bernese Oberland 416
Biscay Basin 360
Bore of the Tide 107
Brazil 827
Buenos Aires 842
Burma 639

California 540
Canadian Railways 476
Canon 159
Cape Breton Island 492
Cape Colony 627
Cape Horn 654
Caribbean Sea 835
Carolina 522
Caspian Sea 323
Catchment Areas 147
Central America 545

Ceylon 796
Challenger Ridge 86
Chile 838
China 807
Cinchona Belt 833
Circles 171
Cirque 151
Climate 172
Colombia 846
Colorado 539
Conical Projection 55
Conifers 167
Connaught 302
Connecticut 519
Consequent Streams 157
Constant Winds 120
Continental Climate 144
Contours 60
Convergent Valley 67
Co-ordinates 42
Coral Islands 88
Cotton States 522
Cradle of Civilisation 774
Crumpling of Rocks 76
Crust of the Earth 73
Cuba 550
Cyclones 116
Cylindrical Projection 58
Cyprus 624

Dakota 533
Deciduous Trees 166
Dekkan, The 796
Demerara 849
Denmark 388
Denudation 81
Deserts 165
Diameter of the Earth 20
Diatoms 93
Digitate Delta 161
Divide 68
Dolphin Ridge 86
Durham County 247

Earth Sculpture 78
East Anglia 267
Eclipses 16
Ecuador 828
Eden Valley 250
Egypt 624
Elbe, River 382
England 247
Equable Climate 144
Equinoxes 31
Escarpments 71
Estuary 307
Europe 307
Euxine 325

Falkland Isles 838
Fiji Isles 689
Firn 151
Fisheries 84
Florida 525
Form of the Earth 15
Formosa 812
France 353

Geneva 416
Geographical Units 165
Georgia, South 838
Georgia (U.S.A.) 524
Germany 372
Gibraltar 623
Glaciers 151
Globigerina 92
Gnomon 33
Gobi 819
Gold Mining 509
Gorges 162
Grasslands 166
Great Lakes, The 619
Greece 423
Greenland 553
Guiana 827
Guinea, New 683

Haiti 550
Hampshire Basin 277
Hampshire, New (U.S.A.) ... 519
Highlands, Scottish 291
Holland 369
Horizon 15
Hot Springs 79
Hudson Bay 464

Iberian Peninsula 431
Icefields 151
Illinois 532
Imperialism 663
India 784
Indus, River... 788
Insular Climate 144
Intermittent Spring... 148
Iowa 533
Ireland 298
Isobars... 113
Isotherms 136
Istria 410

January Winds (*N. America*) ... 458
Japan 813
July Winds (*N. America*) 460
Jura Ranges... 416

Kansas 534
Kent 273
Kentucky 530
Knoll 67
Korea 812
Kuro Siwo 815
Lake District 250
Lakes 163
Lancashire 258
Land Breeze 126
Latitude 43
Laurentian Valley... 620
Leinster 300
Llanos 833
Local Time 43
Longitude 43
Louisiana 535
Lowlands, Scottish 293

Magdalena, River 830
Malta 623
Man, Isle of 290
Manchuria 805
Maryland 522
Massachusetts 518
Mediterranean, The 417
Mercator's Projection 58
Meuse Valley 368
Mexico 549
Michigan 534
Minnesota 533
Mississippi, River 464
Mongols 773
Monsoons 127
Moon and Tides 99
Mountain Rainfall 132
Mountain Structure... 76
Mountain Uplift 76
Movements of the Earth 23
Munster 302

Natural Waters 149
Neap Tides 104
Nebraska 533
Nevada 542
Névé 151
New Brunswick 493
New England 463
New Guinea 641
New Hampshire 519
New South Wales 678
New Zealand 632
Newfoundland 491
Nicaragua 550
Nile Valley 658
Northumberland 247
Norway 392

Obsequent Streams 157
Ocean, The 85
Ocean Currents 94
Ocean Deposits 92
Ocean Temperatures 91
Ocean Waters... 89
Ocean Islands 88
Ohio 530
Ontario 496
Orbit, Earth's 35
Oregon 540
Orinoco 827
Orographic Map 68
Orthographic Projection 48
Ouro Preto 850

Pacific Ports 484
Pacific Routes 485
Pacific States 464

Palmate Delta 161
Pamir Plateau 763
Pampas, The 833
Panama 828
Paraguay 827
Parana 827
Paris Basin 357
Patagonia 827
Pennsylvania 520
Perihelion 35
Peru 837
Plankton 90
Plate River 850
Po Basin 426
Poles of the Earth 21
Portugal 431
Pressure of the Atmosphere ... 109

Quebec 494
Queensland 676

Race, Tidal 107
Races of Man... 761
Radiate Valley 66
Radiolaria 92
Rain Barrier 829
Rain Shadow... 133
Ranch Farms... 618
Red Clay 93
Red Sea 658
Rhine Valley 380
Rhode Island 519
Rhodesia 637
Rhone, Swiss 416
Rhone, French 361
Ribbon Lakes 164
Rio Janeiro 842
River Terraces 158
Rocky Mountains 537
Rotation of the Earth 27

Saddle 65
St. Lawrence, River 489
Salt Lakes 164
Saskatchewan 500
Savannah 166
Scandinavia 392
Scheldt, River 367
Scotland 291
Sea Breezes 126
Seasons 28
Sections, Map 60
Seismic Line 74
Semites 773
Severn Basin 282
Seychelles, Islands... 658
Siberian Railway 778
Size of the Earth 17
Snow Line 151
Somaliland 637
Soudan 635
South Africa 733
South America 819
South Australia 629
South Temperate Zone 605
South Wales... 287
Spain 431
Springs 147
Spring Tides 103
Spur 63
Stereographic Projection 50
Storm Tracks... 452
Straits Settlements 785
Subsequent Streams 157
Suez Canal 657
Sussex 273
Switzerland 412
Syncline 78

Tasmania 682
Temperature 137
Temperature, Range of 143
Tennessee 530
Thames Basin 269
Tides 98
Time, Local 43
Tonga Islands 689
Trade Winds... 125
Transcaspian Railway 780
Trent Basin 260
Trinidad 849
Tropical Africa 576
Tropical Australia 640
Tropical Forest 166
Tropical Rainfall 576
Tropics, The 38
Tundras 166
Turkey in Asia 772
Tuscarora Deep 86
Tyrrhenian Sea 428

Uganda 636
Ulster 298
Uplands, Scottish 295
Uruguay 845
Utah 542

Valley Erosion 160
Vancouver Island 406
Vegetation Types 165
Venezuela 846
Vermont 519
Victoria 631
Virginia 522
Volcanoes 74

Wales 287
Wash, The 264
Watershed 68
Weald, The 273
Weser, River 382
West Africa 635
West Indies 634
West Virginia 530
Wheatlands 618
White Sea 326
Wyville Thomson Ridge... ... 89

Yorkshire 252

Zones of the Earth 39
Zig-zag Valleys 508

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